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THIRD ANNUAL REPORT

SEASON OF 1913

PRIEST RIVER EXPERIMENT STATION

DISTRICT 1

By

Donald R. Brewster

Forest Examiner in Charge

December 15, 1913.

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PART I

ADMINISTRATION

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1. General

This report marks the completion of the second growing season since the establishment of the Station. During this field season, administrative matters and improvements required much less attention than previously and much definite progress was made in investigative work. Matters of policy and organization were worked out on a satisfactory basis and a fund of practical experience was obtained which will add to the efficiency of the Station during the coming year.

In making this report it was thought best to divide it into two distinct sections, Part I to deal with administration with a brief mention of investigative work as a whole, and Part II to cover a more detailed report on each investigative project. Part I is comparatively short and several copies can be made for general distribution, if desired, while Part II is necessarily longer and need be furnished only to other Experiment Stations and those especially interested in the details of the work. Matters in Part I are discussed under the following heads:

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2. ORGANIZATION

In line with the District Policy of concentrating most of the silvicultural investigations at the Experiment Station or under its supervision, the Officer in charge of the Station has been made directly responsible to the Assistant District Forester in the branch of Silviculture for the conduct of all such investigative work being carried on in the District . This will mean a certain amount of additional administrative work on his part in handling District correspondence, preparation of District reports, and in keeping in more direct touch with investigative work not supervised by the Experiment Station. Owing to this decrease in the amount of time he can give to the work of the Experiment Station proper and to the increase in volume of work turned over to the Station by the policy of concentration, he should have

two technical assistants instead of one. The need for t three man staff was so apparent during the past season that such an organization has already been formed and it is phanned to make it permanent.

At present then, the force consists of one Forest Examiner in charge of the Station and also of District Investigative work, one Forest Examiner who is second in responsibility for the work of the Station, and one Forest Assistant, third in responsibility for Station work. In addition, a handy man is necessary the year round to maintain the plant, care for stock, do minor improvement work and odd jobs, provide fuel, and help with the outdoor experimental work. The present isolated position of the Station from other National Forest land makes it advisable to provide for fire protection. A special fire guard is needed for this purpose during July, August, and September, who can spend his time in patrol and lookout work in dry seasons and partially in trail-building and other improvement work connected with protection during favorable seasons. The handy man would have charge of the fire-protective work in the summer in addition to his regular work, and would form an essential part of the protective force.

A considerable amount of clerical work is unavoidable in connection with the administration of the Station. Many letters and reports must be written in the course of a year, although every effort is made to reduce such work to a minimum. Accounts must be kept, records and correspond-

ences must be filed, supplies must be purchased and requisitioned, vouchers must be prepared, and property records must be kept. Altogether, there is enough of such work to occupy a large part of one person's time. It is felt, however, that it is unnecessary and undesirable at present to provide special clerical help. The funds needed for this purpose could be used to better advantage as part of the salary of the third technical man, with the provision that the clerical work be divided up among the three men of the staff. In this way, every saving made by reducing correspondence, etc., could be applied directly to the investigative work. Under this plan, it will be necessary for each of the three men to learn the rapid use of the typewriter and become familiar with the account-keeping and other office work, so that letters can be written directly almost as quickly as they could be dictated and so that the other work will take a minimum amount of time. In preparing long reports, the first draft will be rapidly written on yellow paper and corrected and then forwarded to the District Office where the final copy will be made by the regular stenographers, who will also handle any other copying or similar work which can be delayed one or two weeks.

3. STATION TERRITORY

By proclamation of March 3, 1913, the State of Idaho was given the right to select practically all of the Kaniksu Forest east of Priest River and Priest Lake in exchange for school sections in other localities. A total area of 4250

acres was reserved for the use of the Experiment Station, which is entirely surrounded by State selections, leaving the tract isolated from the rest of the Kaniksu. Almost all of Benton Creek and the lower half of the South Fork of East river are included in the Station territory and it all is covered with forest, roughly about one-third mature and two-thirds immature and from forty to fifty years old. It was reserved in order to provide sufficient room and variety of sites for future management and type studies.

During the past summer, Mr. Mason suggested that the contemplated experiments on management could be more easily handled and would be of greater value if the entire Station area could be put under intensive forest management, to be handled as a complete working circle under an individual working plan. Being similar in climate, soil, and topography to large areas within the Forests of Northern Idaho, it was thought that the experience gained in managing this small tract would serve as a valuable guide to the manggement of the larger watersheds of which it is typical. The location is particularly favorable for this purpose. Both creeks flow directly into drivable streams and no part of the area is more than four miles from banking ground, most of it being much closer. A main logging road for sleighs can be constructed up each valley on easy grades. All side gulches are short and easily reached from the main road by skidding and dray-hauling. The 16 miles of the Priest River below the Station are excellent for inexpensive driv-

Plate 1.

Second Dwelling Cottage, for Use of Married Assistant.

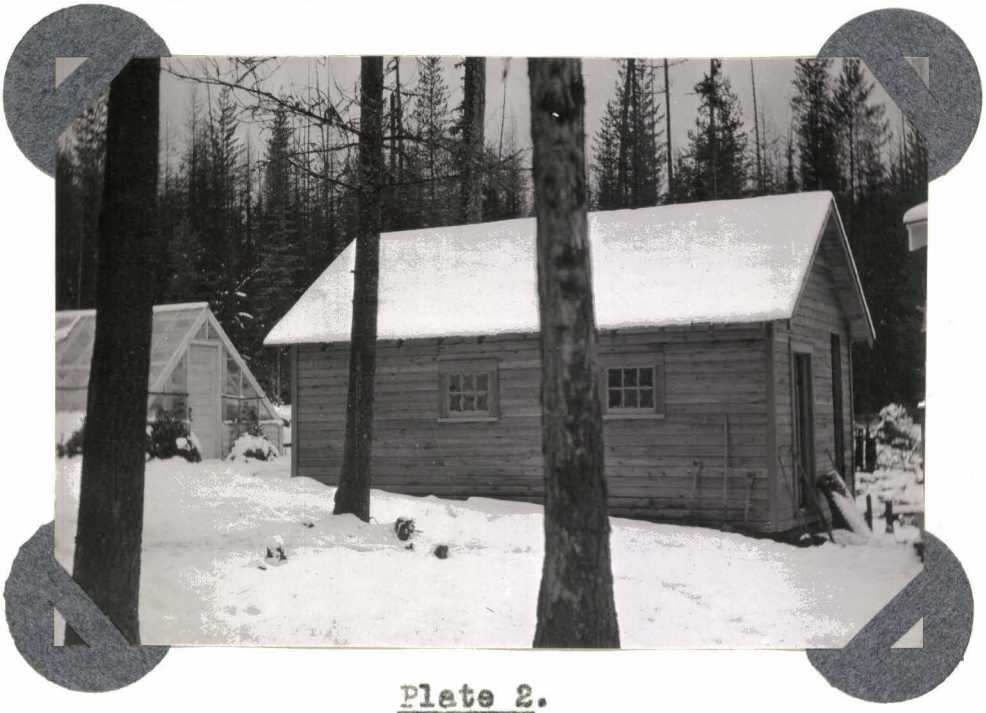

Plate 2.

Combination Shed, Used as workshop and for Tools and Wood.

ing of logs and there are several saw-mills and other wood-using industries on the Pend Oreille, near the mouth of Priest River, which can utilize all of the products of the Station for an indefinite period in the future. For non-agricultural timber land the area is particularly accessible for logging and marketing and is therefore well adapted to the use of intensive methods of management on a commercially profitable basis.

All important timber types are represented, with a considerable preponderance of the white pine type which it is particularly desired to study. The large proportion of well stocked young growth of about half the rotation age together with the balance of mature timber will make the establishment of the proper distribution of age classes simple. Each watershed will make a management block, which divides itself naturally into a number of compartments in the shape of side gulches which are fairly uniform in size and easily handled as logging units.

When comparatively large solid bodies of timber are ready for sale, contracts can be made to local logging contractors who are equipped to handle operations of some size. These larger sales can be limited to intervals of ten years or whatever period is desired between age classes. At the same time, small and detached units can be disposed of to the local ranchers who will be glad to do such work in the winter. These smaller sales can be made each year in such a way as to fully utilize all of the timber, give the local men steady winter employment, and keep the roads

and main improvements in continuous use and repair. Such sales can be made without undue expense because supervision will be incidental to the main work of the Station and should take very little extra time. With this accessibility of the timber and close utilization, great flexibility will be possible in management and there will be opportunities for conducting much valuable experimental work in connection with the cutting.

The advantages of placing the area under management are so apparent that the necessary preliminary work of reconnaissance has already been started and will be completed during the present winter and spring. Two men from one of the regular reconnaissance crews have been assigned to the work and will be assisted by members of the Station force whenever necessary. It is planned to make the reconnaissance very intensive and accurate and a model of its kind. A 20% estimate will be obtained by running strips every five chains and the contour interval will be 20 feet. Vertical control is obtained by means of a transit stadia survey around the boundaries and also along the center section line, furnishing a check on elevation for every mile of strip run. In sketching, elevation will be obtained by Abney level and two-chain tape. Horizontal control will be by Land Office Survey section lines. Estimate strips will be run with standard compass and jacobstaff.

With the reconnaissance data as a basis, a working plan will be drawn up during the summer, after which sales of green timber can be started. Some small sales of dead

cedar fence posts and fire-killed white pine and larch have already been made to ranchers this winter who have shown much interest in this opportunity for employment during the slack season. Sales will be handled directly by the Station force under the supervision of the District Office. Monthly reports of timber cut and sold will be made to the Supervisor for inclusion in the Kaniksu report.

Since it is planned to make this intensively managed area an example of what can be done with larger water-sheds, it would be desirable to include not only the lower and better parts of each valley as at present, but also the upper and less productive land at the head waters. Thus the complete water-shed would be included and the yield per acre would be more representative of the larger areas. To this end, additions to the Station aggregating 2300 acres have been recommended, including all of the land at the head-waters of both creeks which is needed to make the water-sheds complete and some small pieces needed to fill out certain logging units. It is hoped that an arrangement can be made with the State by which it will revoke its selections on this land in return for the right to select an equal amount of more desirable land close to the river.

4. IMPROVEMENTS

During the year a second $650 cottage, containing four rooms and an attic was erected for the use of the married technical assistant. It is shown in plate I. The other assistant and the handy man are using the kitchen and up-

stairs rooms of the laboratory building. If either of these positions is later filled by a man with a family, the front three rooms of the Benton Ranger Station which is one-quarter mile from the other buildings are available. In anticipation of such a need, an extension of the water system was made to the Benton cabin during the summer by means of 1600 feet of 1-inch iron pipe. A shed, shown in Plate 2, one end of which is for wood and ice and the other for a workshop and tool house, was built to replace the old one which burned in June.

The plowed portion of the meadow was sown to oats mixed with different grasses to see which grass was best adapted to the soil. As shown in plates 3 and 4, a good crop of oat hay was secured. The unoccupied nursery ground was used partly for garden crops and partly for a green manure crop of mammoth red clover. Half an acre of additional meadow land was cleared.

The improvements needed for the coming year include about four acres clearing and some ditching on the meadow; the replacement of rough temporary wood sheds at two of the buildings with permanent ones in keeping with the rest of the improvements; some additional fencing for pasture and for protection of experimental areas; some additional clearing of timber and stumps around the buildings; and other small items.

In connection with the development of the timbered area, it will be desirable to install a telephone line five miles long to a look-out Station at the head of Benton Creek, estimated to cost $250. A start should also be made on the

construction of a main logging road up Benton Creek to the extent of $500. In order to make it possible for small operators to work at different points, it will be necessary for the Station to construct and maintain the principal roads, so that improvement costs will not be prohibitive.

Maintenance of improvements involves a certain amount of alterations, repairs, painting, etc., each year, which can ordinarily be done by the handy man, the principal cost in addition to his salary being for lumber, paint, and other materials.

5 EQUIPMENT

Several articles of equipment were destroyed in the shed fire in June. These were replaced and in addition, a 200-egg incubator for germinating seed and a plow and light farm wagon were purchased. A long and short carriage Oliver typewriter and a second short carriage Underwood were obtained in order that a machine would be available for the use of each member of the technical staff. A Wales nine-bank adding machine was transferred from the District Office. The light team purchased last year has been useful in a number of ways and has been well worth the cost of its maintenance,--at present about $200 a year. This cost will be greatly reduced as soon as the four acres of additional meadow land has been developed and additional pasture put under fence.

6. ACCOUNTS AND RECORDS

The present system of accounts is modeled on the

Plate 3

Crop of Oats on Meadow after First Plowing: Station Cow.

Plate 4

Oats being cut for hay; Nursery and South Slope in Background.

system put into effect July 1, 1913, for use of Supervisors. Only those captions are used which apply to our activities. Each investigative project is a cost-keeping unit. The files have been revised in accordance with the "SI" scheme effective April 21, 1913. All material which does not belong under "SI" is filed under its regular Service designation. This method of filing has proved much more satisfactory than the old one. The "SI" scheme is especially useful for our work.

In keeping records of field planting experiments, a large white-print form is used, on which all the details of installation and the results of the work being done under any project can be grouped for ready reference and comparison. Information in regard to installation is condensed for field reference on a blue printed chart of each experimental block of plots.

As a record of the size and development of planting stock used in experiments, representative plants are dried in a plant press and a brown print negative made of them by simply putting the plants against the glass of the printing frame and the paper behind them and exposing to the light. The actual size and the delicate tracery of the finer roots is very well shown in this way. A sufficient number of blue prints can be made from these negatives for a file record and for use as an appendix to progress and final reports on projects. Similar records are made when necessary in nursery experiments and studies of natural reproduction.

V. INVESTIGATIVE PROGRESS

Taking the work by groups, the progress made on the twenty-one approved investigative projects assigned to the Station can be summarized briefly as follows:

a. Seed

Projects FS-1. Fs-2, Fs-3, Fs-4.

Sixty current germination tests have been made during the year in connection with the white pine and yellow pine seed extracting experiments carried on by the Section of Planting. Intensive experiments at three different nurseries furnished definite information on the difference between germination in greenhouse tests and in nursery beds. Project Fs-3 on white pine seed production had been completed in 1912 and nothing further was done with it . The long time experiments on source of seed of yellow pine, white pine, douglas fir and larch, by means of comparison of results in field plantations, was continued by filling in fail places and taking growth records and by the installation of some stock from additional sources.

b. Nursery

Projects Fn-2, Fn-3, Fn-4, Fn-6, Fn-7, Fn-8.

Work on these projects is closely allied and can be summarized as a group. The work on the best season to sow is of value but not yet conclusive. The best depth to sow has been found to be from 1/4 inch to 1/2 inch for yellow pine, white pine, douglas fir, and western larch with only small differences between those depths. A good standard for

these species is thought to be 3/8 inch with allowable variation 1/8 inch either way in practice. From a standpoint of germination and survival, broadcast sowing is best for yellow pine and drill sowing gives best success with larch.

Yellow pine succeeds best in the nursery beds with no shade. Quarter shade is bett for douglas fir and half shade is much the best for western larch under the conditions at Priest River. Experiments in treating yellow pine and larch with different amounts of water and cultivation showed no essential differences due to treatment the first year and will be carried through another year. No great differences appeared in the development of root-pruned and unpruned nursery and planting stock.

6. Planting

Projects Fp-1, Fp-2, Fp-3, Fp-4, Fp-5, Fp-6.

Plantations of five conifers and nine hardwoods were added to the twenty-one species of trees not native which had previously been installed bringing the total up to thirty-five. Most of the latter have survived and made good growth as shown in plate 6. Yellow pine, white pine, and larch age-class experiments show quite uniformly and distinctly that, for our conditions, seedling stock two years old is as good or better than two-year-old and three-year-old transplants in both survival and growth as well as in cost. Fall planting of larch and fall sowing of white pine are clearly best as shown by the experiments on seasons. Seed spot sowing appears to be much superior to broadcast and cornplanter sowing. The cheaper and faster methods of

planting stock in the field succeed quite as well as the slower and more careful methods, under local conditions, and are much lower in cost per surviving seedling. In the study of sites, it has been shown that white pine can be planted with considerable success on gentle south slopes. In general, however, the southerly slopes are more severe than flats and north slopes.

d. Management.

Projects Mc-1, Mr-1, Mt-1.

The study of methods of cutting was strongly emphasized in the season's work and an examination was made of about thirty different cuttings and old burns. It was apparently shown that white pine seed will retain its vitality for from one to four years in the duff and litter beneath mature stands and will finally germinate when the ground is exposed to direct light by cutting. This makes it possible, when cutting white pine stands, to rely for reproduction upon this seed in the duff from previous seed crops to a considerable extent, provided brush can be disposed of in such a way as to leave most of this stored seed uninjured. Because of this fact and as a result of our season's work, it will be possible to modify the marking rules for white pine stands so as to favor the operator by allowing him a larger part of the stand and so as to favor the Service by greatly reducing the investment in seed trees previously thought necessary for securing a restocking of cutting areas.

The effect upon seedlings of different conditions of shade, soil, moisture, surface temperature, exposure, etc., was studied by means of 60 closely observed plots on three sites. Much valuable information was obtained on the six most important native species,--white pine, larch, douglas fir, yellow pine, western hemlock, western red cedar. A series of four half-acre plots were laid off in a fifty-year old stand of white pine and larch near the Station and the preliminary examination was made by charting and measuring each tree with a view to experiments in different degrees of thinning to be installed next summer.

e. Types

Project T-1. Meteorological readings were continued at representative stations in the three types, including soil moisture and soil temperature, precipitation , air-temperature and humidity, wind velocity and sunshine.

f. Tree Studies

Project TS-1. Studies of the characteristics of white pine seed were continued by attempting to stimulate germination in a number of different ways. Indications of value were obtained which will be followed up by later work.

8. INVESTIGATIVE POLICY

With the exception of projects Fs-3 and TS-1, all of the 1913 projects will be actively continued in 1914. In addition, two new projects are recommended to be included in the group under "Seed." One of these is a study of the characteristics of white pine seed and is just a reclassification

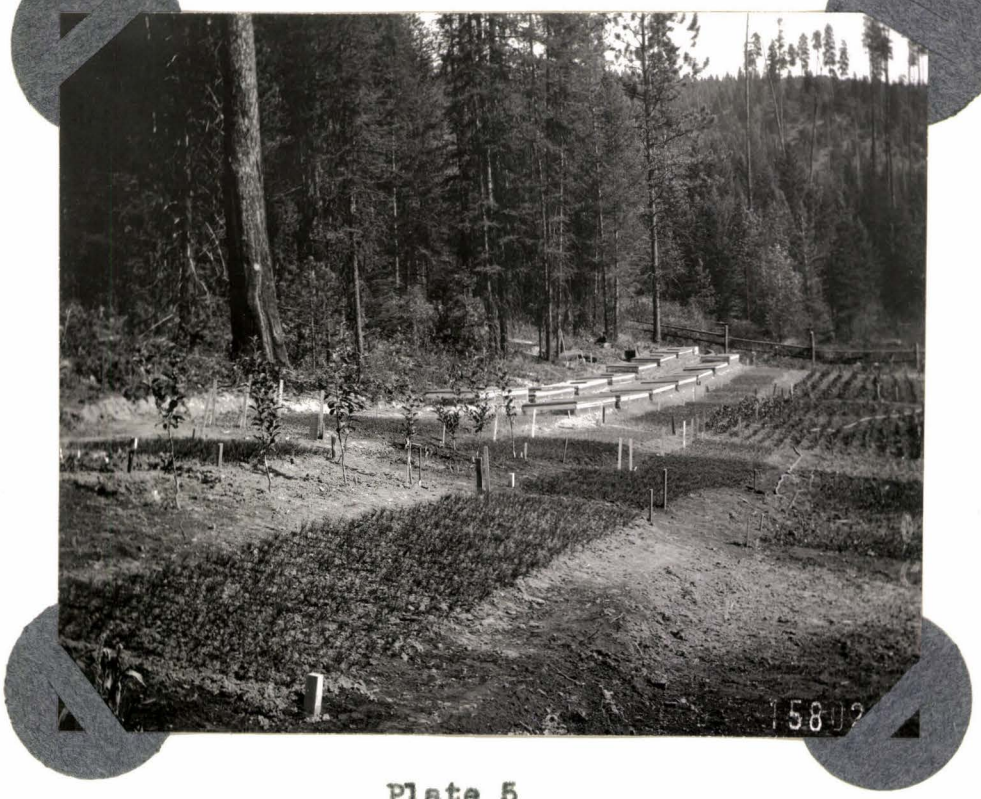

Plate 5

General View of Nursery showing Seed and Transplant Beds.

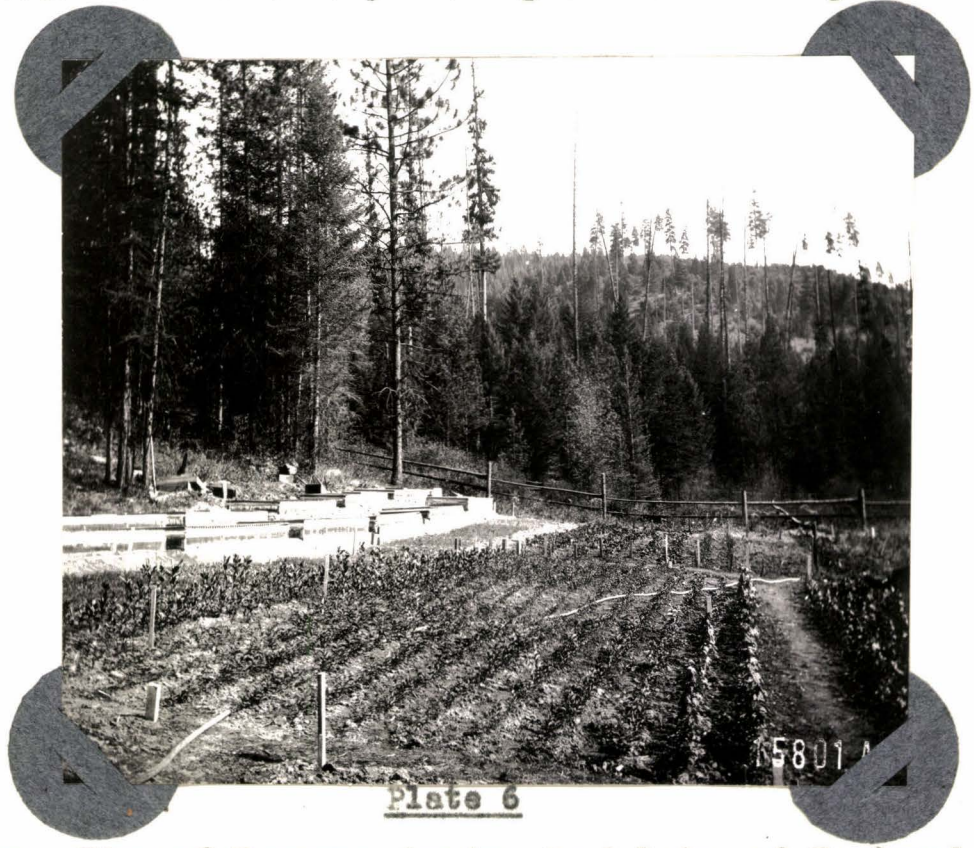

Plate 6

Closer View of Nursery showing Seed Beds and Hardwood Seedlings.

of the work which was done in 1913 under the finished project TS-1. The other new project is a study of the amount and quality of seed produced by over-mature and decadent western white pine trees with a view to determining their value for seed trees in timber sale work. This will leave the same number of active projects as in 1913 and the program included is more than enough to absorb all of the time and resources of the Station.

No further expansion in field of work is thought desirable for the next few years and it is hoped to be able to close out several of the projects now acrive by the end of another season, so that work can be concentrated on a smaller number of the more important studies. Our experience has shown that the attempt to carry a large number of projects concurrently results in loss in efficiency because of the increased office work necessary and on account of the lost motion involved in changing frequently from one line of work to another.

With a permanent investigative force of three men, it is planned to have each one specialize along certain lines of work and assume more or less complete responsibility to the Officer in charge for the planning and reporting of definite projects. This will also apply to the execution of the work, but to a lesser degree since it will be necessary to combine services on single projects in various ways and at different times. Thus, for the season 1914, Larsen will specialize on the type and stand studies and seed work,

Rogers on nursery and planting projects, and Brewster on methods of cutting and natural reproduction studies. Each man will in this way concentrate on the lines he is specially interested in and it is thought that this policy is bound to result in increased efficiency and volume of work. As time goes on the services of each individual will steadily increase in value because of the added experience thus gained in his special line.

In some cases, it will be desirable to extend the field work to other points in the District. This applies particularly to nursery experiments. The present policy is to raise practically all of the planting stock used in the District at the Savenac Nursery. As long as this is done, and since most nursery problems are more or less local in character, it will be advisable to work out those problems right at the Savenac where the results are to be used. On this account the amount of nursery work carried on at the Experiment Station will be reduced to a minimum and the balance will be shifted as far as possible to the Savenac to be carried on with the co-operation of the Supervisor.

Studies of methods of cutting must be located largely on the Coeur d'Alene and St. Joe Forests, at least for the next year or two, since they contain the most suitable areas for such work and are the only Forests in the White pine country on which active cutting on slopes is being carred on at present. Practically all of the balance of the work can be conducted locally in the Station

to the best advantage, with the exception of supplementary tests in other localities to check the results obtained in the Station.

In previous planting experiments, units consisted of 100 plants spaced 5 x 5 in a plot 50 feet square. After observation during two seasons, these experiments have in several cases failed to give conclusive results, partly at least because of the small number of plants used. It is planned to remedy this by using 400 plants spaced 2½ x 2½ in each plot. This will reduce the error due to accidents furnish greater uniformity of conditions for the same number of plants, and give much more reliable information at only slightly increased cost. This plan was followed in the white pine planting in the fall of 1912 with good results and was used in all work installed in the fall of 1913. It will be followed in the future in most short-term experiments on methods, seasons, classes, and sites, not established primarily for reforestation purposes.

A further development in planting work planned, is to have a certain area close to the buildings cleared and cultivated and devoted to small intensive experiments which can be kept under close observation. This will form a parallel to the "experimental gardens" found at most European Experiment Stations. The principles worked out in these small studies can then be tested out on a large scale in connection with regular field planting.

In the future, planting and nursery investigations should be conducted with the close co-operation of the Section of Planting in the District Office. Principles worked out in the Station should be tested in connection with regular forestation projects. It is planned to carry on these tests on specially designated experimental areas, one at Placer Creek on the Coeur d'Alene, and the other probably on the Deerlodge,--areas typical of the regions concerned and easily accessible for observation by those interested. Supplementary planting tests can also be located on other areas by merely staking a certain number of the plants put in in the regular course of the work. Each plant so staked should have a number so that future counts can be made by number and confusion of individuals be thus avoided. Each group of staked plants should be given a plot number starting with 1, serially for the designated planting areas and the number marked plainly on a large square post placed at one corner of the plot. A method similar to this has been used with success in District 6 for keeping a check on results of field planting. Bu its use the initiation of much purely experimental work can be avoided and the necessary information can be secured at a considerable saving in time in expense.

The section of Planting should be furnished with the first draft of all working plans for forestation experiments, which should be subject to their criticism and review. In this way, the tendency toward getting away from the most practical phases of a problem, which has been pres-

ent in some cases in the past, could be corrected and the investigation work could be concentrated on the most urgent problem coming up for solution in practical field work. Whenever additional experiments are needed the Experiment Station should be consulted in the preparation of the plans. Also the two forces should co-operate in making field counts and observations wherever possible and should keep in close touch by frequent exhhange of reports and memorsnda b and by working together in the field.

There has been some difficulty in keeping costs and records of planting and nursery work because of the present classification of projects. In several cases work on two or three or even more projects has been carried on simultaneously in the same nursery bed or planting plot in accordance with the same field working plan. In these circumstances, in order to retain the project as a costkeeping unit it is necessary to pre-rate the costs among the projects concerned. And in order to keep each project file complete, duplication of all plans and records is required for each of the projects concerned. This involves considerable additional non-productive office work and is apt to cause confusion in later reference to the work. The trouble is due of course to the fact that the project classification is based on rather minute phases of the work and it is often convenient and sometimes unavoidable to combine the study of several of these phases in one working unit.

District 6 has found this same trouble and the remedy which they suggest of using the species as the basis

Plate 7

Black Locust ten feet tall, planted as a 2-year seedling 24 inches long, in the spring of 1912. Shows growth during two seasons on good white pine land on level bench near river.

of classification seems to eliminate most of the difficulties. The project could be made broad enough to cover all phases of the planting work or the nursery work that it was desired to study in connection with any one species. Only those species which play an important part in the reforestation work in the District should be included and the various problems connected with them could be attacked in the order of their importance as indicated in the working plan for each project. In this way, all information in regard to planting of any important species or nursery work with any species could be assembled in the project file automatically where it would be readily available for reference. Cost and record-keeping would be simple since it would seldom be desirable to combine different species in the same experimental unit. It is believed that this classification by species would be superior to the present system for all nursery projects and for all planting projects except Fp-1, which covers small tests with a number of species. It is recommended that steps be taken by the District Committee to re-classify these projects on a species basis.

The value and necessity of preparing complete working plans for projects, in advance of execution, is recognized. Our idea of such a working plan is that it should cover the following phases of a problem: (1) Work already done and information on the subject obtained in previous investigations and in practical experience. (2) Scope and nature of the work planned under the present project. (3) Location of field work, methods to be used,

equipment needed, and assignment. The preparation of such a plan requires more or less preliminary work as well as some time in assembling the final complete plan. Up to the present time, it has been impossible for the forces at this Station, working under pressure for results, to prepare more than preliminary and fragmentary plans for its projects, judged by the above standard. From now on, however, with a permanent three-man staff dividing the responsibility and with stenographic help in the District Office, it is felt that plans can be prepared in advance of all field work so that they can be reviewed and approved by the Central and District Committees. In line with this policy, the best plan possible in such a limited space of time will be prepared to cover the 1914 work on each active project and submitted by March 1, 1914.

Since it is necessary to submit the annual report of the Experiment Station to the District Committee early in December it is thought that the investigative year should end November 30 so that complete annual costs can be included. This policy has been followed in the present report and costs have been figured for the eleven months from January 1 to November 30, 1913. This period is designated as the "investigative year 1913".

9. COSTS.

The expenses of the Station for the investigative year 1913 were as follows:

Total Expenses, Priest River Experiment Station, 1913.

Period	Operation	Improvements	Investigations	Totals.
First Half 1/1 to 6/30,	$1455.21	$1402.76	$1307.17	$4163.14
Second Half 7/1 to 11/30,	740.68	653.50	1847.97	3242.15
	$2193.89	$2056.26	$3155.14	$7405.29

It is interesting to note the much larger proportion of investigative expense in the last half than in the first half of this period, with a corresponding decrease in the amount needed for operation and improvements. This illustrates the policy which is being followed of reducing the expense of operating the Station to a minimum as soon as possible and putting a maximum of time and funds into the strictly investigative side of the work. It is hoped to make a still greater improvement in this respect during the coming year. The total expenditures of the Station since the it was started, September 1, 1911, are given below:

Period	Operation	Improvements	Investigations	Totals
Fsc. Yr. 1912 9/1/11 to 6/30/12	$1777.87	$3146.02	$1838.72	$6762.61
Fisc. Yr. 1913. 7/1 to 12/31/12/	1250.18	1488.88	657.12	3390.12
Fisc. Yr. 1913. 1/1 to 6/30/13.	1453.21	1402.76	1307.17	4163.14
Fisc. Yr. 1914. 7/1 to 11/30/13.	740.68	653.50	1847.97	3242.15
Totals	$5221.88	$6685.16	$5650.98	$17,558.02

An analysis of the costs for the investigative year 1913, from January 1, 1913 to November 30, 1913, follows:

	Expenses	Salaries	Totals
A. Operation.			
1. Administration	$ 495.98	$ 703.59	$1199.57
2. Sundays, Leave, Holidays (Only from 1/1 to 6/30)	2.50	285.00	287.50
3. Non-expendable Equipment (Only from 7/1 to 11/30)	82.76		82.76
4. Quarters, Fuel, (wood)	65.60	118.39	
Light, (oil)	26.07		
Janitor, work	2.70	92.14	
Repairs	10.65	23.25	
Other	5.76		
	110.78	233.78	344.56
5. Animals, Feed and Care	232.20	52.75	274.95
6. Protection, Fire Suppression.		4.55	4.55
Total for Operation	$914.82	$1279.67	$2193.89
B. Improvements, New Construction.			
1. Roads	32.18	28.75	60.93
2. Fences, Administrative	40.20	20.62	60.82
3. Cabins	658.36	1.25	659.61
4. Other Buildings	218.07	4.83	222.90
5. Water Improvements	273.16	62.16	335.32
6. Other Improvements	343.48	67.60	411.08
Total, New Construction	$1565.45	$185.21	$1750.66
C. Improvements, Maintenance.			
1. Repairs to Roads	7.03	2.89	9.92
2. Repairs to Cabins	158.82	100.25	259.07
3. Repairs to Other Bldg	8.33	6.25	14.58
4. Repairs to Water Impts	15.17		15.17
5. Repairs to Other Impts	5.06	1.80	6.86
Total, Maintenance	$194.41	$111.19	$305.60
Total for Improvements	$1759.86	$296.40	$2056.26

D. Investigations (By Projects)

	Expenses	Salaries	Totals.
1. Miscellaneous and Unclassified..	188.23	209.48	397.68
2. Seed Extraction (Fs-1).....	1.50	67.65	69.15
3. Comparative Germination (Fs-2)..		56.44	56.44
4. Seed Production (Fs-3).....		.70	.70
5. Source of seed (Fs-4).....		31.41	31.41
6. Unclassified Nursery Work.....	29.17	272.04	301.21
7. Best Season to Sow (Fn-2).....	.77	8.35	9.12
8. Depth of Covering Seed, (Fn-3)..		2.09	2.09
9. Broadcase vs. Drill Sowing (Fn-4)	.77	16.90	17.67
10. Amount of Shade on Seed Beds(Fn-6)		12.73	12.73
11. Watering vs. Cultivation (Fn-7)		21.63	21.63
12. Control of Roots (Fn-8) Incidental			
13. Unclassified Planting Work.		222.70	222.70
14. Tests of Species (Exotic)(Fp-1)	31.14	69.61	100.75
15. Classes of Planting Stock (Fp-2)	15.41	72.22	87.63
16. Best Season for Planting (Fp-3)	2.80	31.12	33.92
17. Spacing and Mixtures (Fp-4)		1.94	1.94
18. Methods of Planting (Fp-5)	3.42	36.80	40.22
19. Best Sites for Planting (Fp-6)	2.81	31.22	34.03
20. Methods of Cutting (Mc-1)	320.92	637.44	958.36
21. Natural Regeneration (Mr-1)	28.28	242.21	270.49
22. Thinnings (Mt-1).	7.66	90.55	98.21
23. Met'l Study of Forest Types (T-1)	5.85	305.16	311.01
24. White Pine Tree Study (TS-1)		76.05	76.05
Total for Investigations.	$638.73	$2516.41	3155.14
E. Silviculture, Reconnaissance...	25.75	24.45	50.20
Grand Total for Investigative Year,	$3338.56	$4116.93	$7455.49

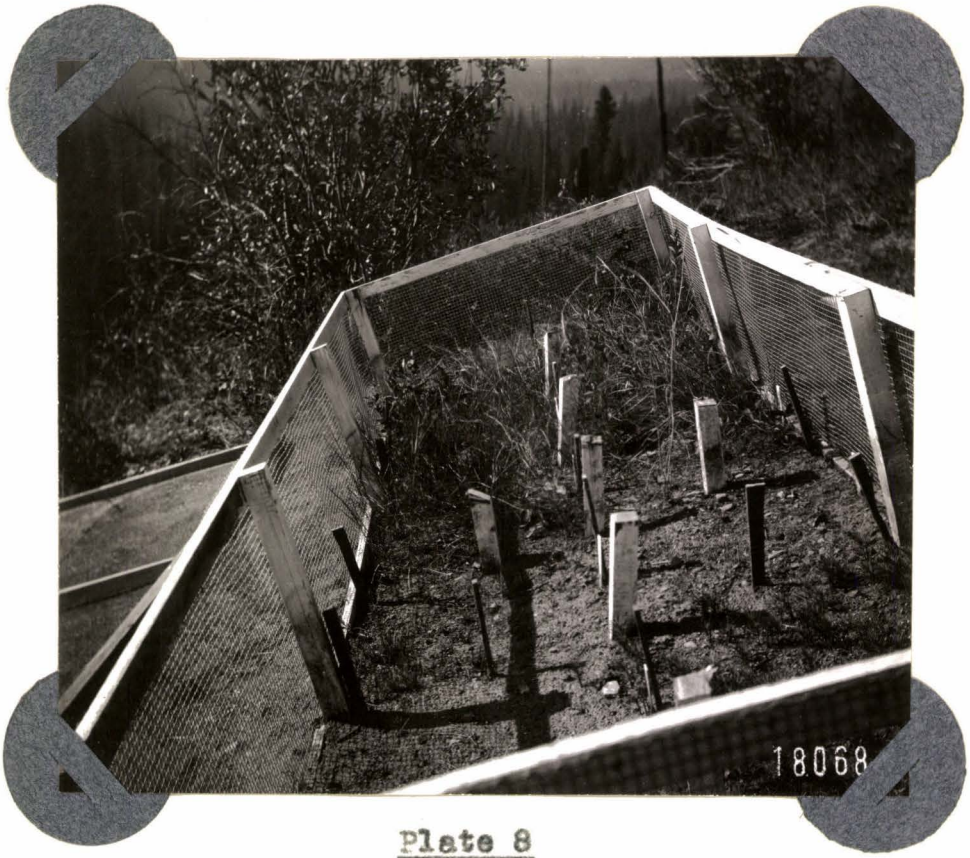

Plate 8

Study of Seedlings Growing on Dry Southwest Slope (Mr-1)
Contrast between Burned Surface and Natural Vegetation.

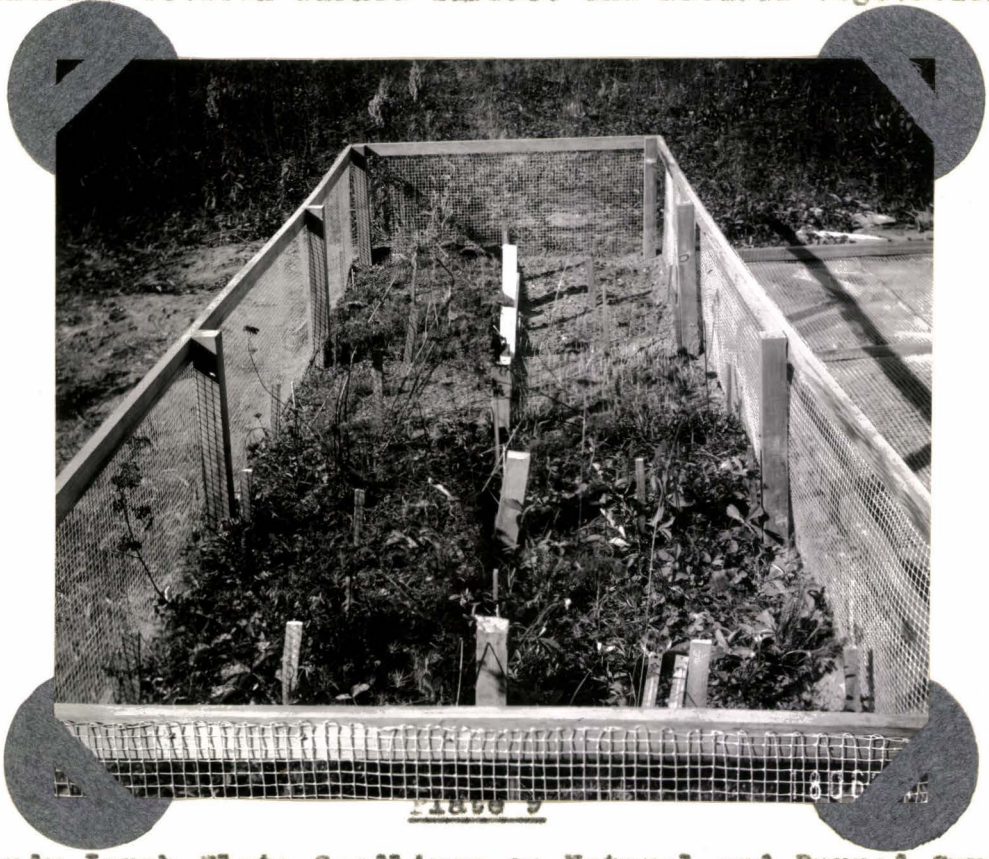

Plate 9

Sandy Larch Flat; Seedlings on Natural and Burned Surfaces.

In the list of investigative costs, item 1 covers equipment, supplies and labor chargeable to several and often an indefinite number of projects and the salaries cover time spent on strictly investigative work connected with several or all of the projects but not capable of subdivision currently among them. Item 6 includes supplies, labor and time spent on the different nursery projects which it was not possible to divide among them currently because of the involved and minute classification of projects. Item 13 serves the same purpose for the planting projects, covering the cost of transporting stock from other nurseries, growing stock in our nursery, making fall and spring counts and observations on planting experiments. and installing units which have a bearing on several projects. It is realized that these three unclassified files are not desirable but they are to a certain extent unavoidable. It is thought however, that the plan mentioned above of six classifying nursery and planting projects by species would simplify the cost keeping and reduce the amounts it would be necessary to include in these miscellaneous unclassified files.

Since the entire costs of the Experiment Station are chargeable to the investigative work, excepting the reconnaissance, timber sales and reforestation work connected with the administration of the Station territory and listed under Silviculture in the files, items 1, 6, and 13 have been apportioned and the operation cost and 10% of total improvements for each calendar year have been divided among the different projects proportionally, as given in the following table:

Total Cost of Investigative Projects to November 30, 1913.

Including Investigations, Operation and 10% of Improvements.

Designation	Project Title	Invst. Yrs. 1911 & 1912	Invst. Yr. 1913	Totals
Fs-1	Seed Extracting	134.16	150.67	284.83
Fs-2	Comparative Germination	47.46	124.44	171.90
Fs-3	Seed Production	180.96	1.36	182.32
Fs-4	Source of Seed	492.30	68.23	560.53
Fn-1	Amount of Seed to Sow	274.49		274.49
Fn-2	Best Season to Sow Seed	161.29	118.25	279.54
Fn-3	Depth of Covering Seed	275.65	24.16	299.81
Fn-4	Broadcast vs. Drill Sowing	148.02	219.73	367.75
Fn-5	Amount of Shade on Seed Beds		158.59	158.59
Fn-7	Watering vs. Cultivation		272.44	272.44
Fn-8	Control of Root Development		25.00	25.00
Fp-1	Tests of Species (Exotic)	468.99	391.77	860.76
Fp-2	Classes of Planting Stock	146.19	332.21	478.40
Fp-3	Season for Planting	245.44	129.41	374.85
Fp-4	Spacing and Mixtures		6.87	6.87
Fp-5	Planting and Sowing Methods	447.08	153.32	600.40
Fp-6	Best Sites for Planting	243.02	129.74	372.76
Fg-1	Methods of Cutting	870.06	2086.61	2956.67
Mr-1	Natural Regeneration Factors		592.46	592.46
Mt-1	Degrees of Thinning		213.75	213.75
T-1	Met'l Study Forest Types	1851.61	677.82	2529.43
TS-1	White Pine Tree Study		165.71	165.71
Total Divided among Projects		$5986.72	$6017.54	$12,004.26
Improvements not included in 10%				5,553.76
Total cost in previous summary, p. 23				$17,558.02
Cost of Silviculture, p. 25				50.00
			Grand Total to date.	$17,608.22

10. Allotments and Estimates.

For the Fiscal Year 1914, ending June 30, 1914. the allotments from all sources to the Station are as follows:

Management Schedule	$4800.00
Promotion	200.00
General Expense (Through Kenikau)	1079.62
Improvement Schedule	250.00
General Expense (Coeur d'Alene). . . .	984.90 (Estimated)
Total . .	$7314.52

Out of this total the greater part of the General Expense money from the Coeur d'Alene will be spent on the reconnaissance of the territory together with at least enough from the other funds to bring the total up to $1000.00. Of the balance, the improvement money was used to complete the second cottage. The remaining $6064.52 covers salaries and wages of about $5300 with the small balance of $764.52 to cover cost of travel, equipment, repairs, minor improvements, forage, etc. The funds remaining available for the first six months of 1914 are barely enough to cover salaries of permanent men, leaving almost nothing for travel, experimental equipment and maintenance and other necessary expenses connected with the investigative work. The work in April, May and June will be noticeably hampered by this lack of expense money and it is highly desirable that a larger amount be provided for this purpose during the next Fiscal Year, if the organization is to be maintained as planned.

The estimated minimum amounts needed for the Fiscal Year 1915 to obtain greatest efficiency with the present organization of three technical men and one handy man, follow:

Estimate of Funds Needed for Fiscal Year 1915.

1. Management Schedule.

a. Salaries.		
Forest Examiner in charge. . .	$1600.00	
Forest Examiner assistant. . .	1400.00	
Forest Assistant.b.	1100.00	
Handy Man, six winter months. .	450.00	
	$4550.00	$4550.00
b. Travel	750.00	
c. Investigative Equipment and Expenses . .	750.00	
d. Maintenance and Repairs.	250.00	
e. Forage for Team.	200.00	
Total Management	$6500.00	$6500.00

2. Improvement Schedule.

a. Meadow, sheds, fences and minor improvements connected with the Station Proper	250.00	
b. Telephone line to lookout point.	250.00	
c. Logging Road up Benton Creek	500.00	
	$1000.00	$1000.00

3. Fire Protection Funds.

a. Fire Guard and Handy Man six summer mos.	450.00	
b. Fire Patrol, July, August, September,...	225.00	
Total Fire Fund	$675.00	675.00

Total allotment needed from all Schedules $8175.00

The need for these funds has been thoroughly covered in the preceeding parts of the report and it is clearly evident if our plans for investigative work and Station development are to be put in effect. Compared with the 1914 allotments, just enough has been added to provide sufficient travel and expense money to do the work to the best advantage. The lack of such money will be keenly felt during the first half of 1914 and will constitute poor economy.

Estimated costs for the investigative year 1914 will approximate those of the Fiscal Year 1915, i. e. $6500.00. This amount will be divided among the active projects about as

given in the table below:

Designation	Title	Amount	
Fs-1	Seed Extraction	.100.00	
Fs-2	Comparative Germination	.150.00	
Fs-4	Source of Seed	50.00	
Fs-5	White Pine Germination	.150.00	
Fs-6	Seed Production, White Pine . . .	75.00	
	Total Seed. . .	$525.00	$525.00
Fn-1	Amount of Seed to Sow	25.00	
Fn-2	Season to Sow Seed	25.00	
Fn-3	Depth of Covering	25.00	
Fn-4	Broadcast vs. Drill	250.00	
Fn-5	Fertilizers in Nursery.	50.00	
Fn-6	Degree of Shade in Nursery. . . .	150.00	
Fn-7	Watering vs. Cultivation	150.00	
Fn-8	Control of Root Development . . .	50.00	
Fn-9	Time of Transplanting	50.00	
	Total Nursery Projects.	$775.00	$775.00
Fp-1	Tests of Species	150.00	
Fp-2	Classes of Stock	350.00	
Fp-3	Season for Planting	150.00	
Fp-4	Spacing and Mixtures	50.00	
Fp-5	Methods Sowing and Planting. . . .	200.00	
Fp-6	Sites for Planting	200.00	
	Total Planting Projects .	$1100.00	$1100.00
Mc-1	Methods of Cutting	2500.00	
Mr-1	Natural Regerneration.	300.00	
Mt-1	Degrees of Thinning	300.00	
	Total Management Project	$3100.00	$3100.00
Pd-1	Study Damping Off	50.00	
T-1	Met'l Study Forest Types	850.00	
TS-1	White Pine Tree Study	100.00	
		$1000.00	$1000.00

Total Estimated Cost, Investigative Year 1914. . . $6500.00

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It is recommended that the foregoing plans for organization, policy and development be approved and that the necessary funds as listed in the estimate be alloted for carrying on the work of the Experiment Station, during the Fiscal Year 1915.

Part II of this report, which follows, covers the individual investigative projects in detail.

December 15, 1913.

Forest Examiner in Charge.

THIRD ANNUAL REPORT OF THE PRIEST RIVER EXPERIMENT STATION

SEASON OF 1913

PART II

INVESTIGATIVE WORK

Twenty-one separate investigative projects were approved by the Central Investigative Committee and assigned to the Priest River Experiment Station for the season of 1913. Fourteen of these were classed as "No. 1", --most urgent and to be given first attention; five as "No. 2", --less urgent but desirable if they could be carried in addition to class 1; two as "No. 3", --least urgent, which could be allowed to wait over if necessary. Following is a list of titles, designations and classes:

	Designation	Title	Class	Importance
1.	Fs-1	Seed Extraction	2	18
2.	Fs-2	Comparative Germination in Greenhouse and Field	2	9
3.	Fs-3	Seed Production	3	21
4.	Fs-4	Source of Seed	2	17
5.	Fn-2	Season for Seed Sowing in Nursery	1	14
6.	Fn-3	Depth of Covering Seed in "	1	13
7.	Fn-4	Broadcast vs Drill Sowing	1	6
8.	Fn-6	Different Degrees of Shading	1	7
9.	Fn-7	Cultivation vs Watering in "	1	8
10.	Fn-8	Control of Root Development	1	12
11.	Fp-1	Tests of Species	3	10
12.	Fp-2	Comparison Classes of Stock	1	4
13.	Fp-3	Season for Sowing and Planting	1	11
14.	Fp-4	Methods of Sowing and Planting	2	20
15.	Fp-5	Methods of Sowing and Planting	1	5
16.	Fp-6	Study of Sites for Planting	1	15
17.	Mc-1	Different Methods of Cutting	1	1
18.	Mr-1	Natural Reproduction Factors	1	3
19.	Mt-1	Different Degrees of Thinning	2	19
20.	T-1	Meteorological Study of Types	1	2
21.	TS-1	Western White Pine Tree Study	1	16

An effort was made to adhere to the classification of the Committee as far as possible, but various combinations of circumstances and administrative reasons made it desirable to lay more stress on some projects than on others and to do work on the class 2 and 3 projects at the expense of some of the class 1 projects. The greatest amount of time and expense was put on project Mc-1, No. 17, Effect of Different Methods of Cutting, because of the urgent need of additional information on this subject for use in timber sale work. The approximate relative amount of time and expense put in on the other projects is indicated by figures in the column headed importance, ranging from 1, the greatest, to 21, the least.

Owing to the short period of time from the close of the field season, about the middle of November, until the meeting of the District Investigative Committee, December 15, it is impossible to submit complete progress reports for each project at that time. Since working plans for the next seasons work are called for by January 15, the preparation of the detailed progress reports must be delayed until after that date, owing to the definite limitations of time, stenographic facilities, etc. The data for each project has, however, been tabulated and put in such form that the work and results can be summarized for the information of the District and Central Committees. Such a summary by projects, follows:

1. Project Fs-1, D-1, Priest River

Title SEED EXTRACTION - DISTRICT 1

Work Previous to 1913:

Benddict's report on work done on the Minnesota, January, 1912.

Keach's experiments in extracting western white pine at the Kaniksu seed camp spring of 1912, according to outline prepared by Section of Planting. Most of the individual experiments were divided into five samples for germination tests, immediately and after a period of storage of 6 months, 1, 2, and 3 years.

Work Done in 1913:

Germination test of Keach's white pine experiments after 1 year in storage, May, 1913.

Experiments by Keach in extracting western Yellow pine carried on during the late winter and spring of 1913 on the St. Joe Forest according to outline prepared by the Section of Planting. Individual experiments were divided into five samples for germination tests immediately and after being in storage for 6 months, 1, 2, and 3 years.

Germination tests were run of the "immediate" yellow pine samples during the summer, the balance being put in cool storage.

Summary of Results:

Since the storage tests have not yet been completed in accordance with the working plan, it is not

thought worth while to include detailed figures, or to attempt to give an idea of how the experiments are working out. A set of tables will be prepared for the later detailed progress report.

2. Project Fs-2, D-1, Priest River.

Title COMPARATIVE GERMINATION IN THE GREENHOUSE AND FIELD

Work Previous to 1913

One seed bed at three nurseries, containing twelve samples and six species was counted frequently during the season and the seedlings pulled as counted. The first season average for four species was as follows:

Pinus ponderosa - - - - - - - - - 56% of green house test
Larix occidentalis - - - - - - - 27% " " " "
Pinus contorta - - - - - - - - - 66% " " " "
Pseudotsuga taxifolia - - - - - 58% " " " "

The results with Pinus resinosa and Pinus monticola were thrown out because of error in the first case and incomplete germination in the second.

Work Done in 1913

Counts were made during the spring and early summer on the beds used during the previous year in order to include any seed which had lain over until the second spring. In addition two new 4x12 beds were sown at each of the same nurseries,--Boulder, Savenac, and Experiment Station. One sample of 12 different lots of seed was sown in each bed in a plot 2 feet square and the two beds were located in different parts of the seed bed area so as to represent average conditions for each nursery. There were three samples of Pinus ponderosa, four of Ps. taxifolia, two of Larix occidentalis, one each of Pinus contorta, Pinus sylvestris and Picea excelsa. The several

samples of the same species were from widely separated sources, an attempt being made in this way to arrive at a better average for the species and to study the differences in germination due to source. Each sample was sown at what was considered the most favorable depth for that species, varying ffom 1/2" for the yellow pine to 1/4 inch for the larch. Counts were made at intervals of 4 to 7 days throughout the season. At Priest River the seedlings were marked with a toothpick and left in order to study survival.

Results:

In the 1912 beds the Pinus monticola showed additional germination varying from 15 to 41 per cent and averaging 28 per cent, while the other species averaged from 1 to 3 per cent increase, individual plots going up to 10 per cent. Taking the depth for each species which showed the highest germination, the following table shows the final results from these beds:

Plot:	Species	Depth	Total Germination %				Gr.H.: %	% of G.H.%
			Sav.	P.R.	Boul.	Average		
1a	P. ponderosa	1/2"	51	41	32	41	70	59
2a	L. occident.	1/4"	29	10	6	15	45	33
3b	P. monticola	1/2"	49	27	19	32	74	43
4a	P. contorta	1/4"	60	45	44	49	71	69
5b	P. resinosa	1/2"	77	73	67	73	43	170
6a	Ps. taxifolia	1/4"	64	60	45	56	91	61

In comparing these figures with the 1913 work it

should be remembered that the germination tests were made under somewhat unfavorable conditions in Petrie dishes while the 1913 tests were made in a well heated greenhouse in sand flats. The sowing in 1913 was from one to two weeks earlier than in 1912 which would also cause a variation in germination. A summary of the 1913 results is given below:

Test No.	Species	Source	Per cent of Green House % : Sav.	P.R.	Boul.	Aver.	By Sp	G.H. Test
1.	P. ponder.	Kaniksu	102	120	85	102		56
2.	"	Bitterrt	116	92	106	105	94	64
3.	"	Lolo #1	61	91	73	75		61
4.	Ps. taxif.	Kaniksu	63	75	41	60		51
5.	"	Madison	81	112	75	90		50
6.	"	Wenatchee	85	99	71	85	67	85
7.	"	W. Wash.	27	44	29	33		34
8.	P. contort	Madison	85	79	69	79	79	81
9.	L. occiden	Blackft	77	61	25	55		45
10.	"	Colville	230	160	82	158	107	15
11.	P. sylvest	Riga	65	51	54	56	56	59
12.	P. excelsa	Europe	92	63	93	83	83	30

An astonishing and inconsistent variation in the germination at the different nurseries is shown. Six of the highest figures for each lot are in the Priest River column, five in the Savenac column and only one in the Boul-

der column. The figure given in the table is based on an average of the two beds at each nursery, which also varied considerably in the case of several of the lots of seed.

These variations are probably due to one or more of three causes: (1) Difference in soil, climate, and treatment. The soil and climate of the Savenac and Priest River is quite similar and handling has probably not differed greatly while the soil and climate at Boulder is distinctly different from either of the others. This difference seems to show up both years in the noticeably smaller percents secured at Boulder. (2) Differences in the character of the samples used. Although great care was used to make all samples uniform by using the seed mixer and sampler, it is possible that there might have been more good seed in one than in another. (3) Rodents and fungus diseases. Some of the plots might have been more or less affected by the eating of seed by mice although all ordinary precautions were taken such as screening, etc. Also there might have been more damping off present in some plots than in others, causing death of some seeds before their appearance above ground as well as afterwards. The three yellow pine plots in one bed at Priest River were known to have been disturbed by mice and all three made a much poorer showing than the other bed. For this reason their results were not included in the averages.

The fact that four of the different samples showed a greater germination in the nursery than was obtained in

the greenhouse is also interesting and indicates that there is room for improvement in seed testing methods. The counts show that in all of these cases the germination in the green house was greater than that in the field during the same number of days. In nursery practice, however, it will be necessary to consider the germination during the latter part of the season since we have found that a considerable part of such seedlings survive. It will probably be desirable to work out usable ratios on a basis of a partial germination test in the greenhouse in which case the results to be expected in the nursery may be considerably larger than the green house test. In order to do this it will be necessary to carry on this same sort of work for several more seasons to include full season counts in the nursery and six months tests in sand in the greenhouse.

Further Work Planned.

It is not yet possible to draw conclusions from the work on this project but several valuable points have been brought out in regard to germination and it is thought that if the work is carried further our knowledge on the whole subject of seed germination will be greatly increased and the results will be of much practical value. It is therefore, planned to install two beds at each nursery during the 1914 season and handle them as nearly as possible like those of 1913.

3. Project Fs-3, D-1, Priest River

Title SEED PRODUCTION, DISTRICT ONE, WESTERN WHITE PINE

Work Previous to 1913.

Field work in 1911 on the Kaniksu and Coeur d'Alene Forests. Four sample plots taken with necessary notes. Seed tested for germination at the Washington Seed Laboratory in 1912. Notes and data turned over to Washington office.

Work Done in 1913.

No work was done on this project since it was classed as least important and because there was practically no white pine seed crop within reach of the Experiment Station. An attempt was made to have the Coeur d'Alene Forest measure some more plots because of the good seed crop on that Forest but various things made it impossible for them to do so.

Further Work Planned.

Since this individual project was to have been completed June 1, 1913, and the only further work listed in the program was compilation of results by the Washington Office, it is recommended that the project be considered completed as far as the Experiment Station is concerned and omitted from its program for 1914.

It is planned to keep as close a record of the periodicity of white pine seed crops as is possible, incidental to other work and at no additional expense, so as to accumulate a valuable series of records on this matter.

4. Project Fs-4, D-1, Priest River

Title SOURCE OF SEED, DISTRICT ONE
Western White Pine
Western Yellow Pine
Douglas Fir

Work Previous to 1913:

Nine lots yellow pine and five lots douglas fir have been planted in field at Priest River Experiment Station, using 100 plants of each lot, spaced 5x5 in plots 50 feet square. Several lots of seed of these species from other sources and of white pine were sown in nursery and 1-year seedlings produced.

Work Done in 1913:

The 1-year seedlings were transplanted in the spring to be left for 2 years in transplant beds and then planted in the field.

Counts of field plots were made in spring and fall. Fail places were filled in this fall on all planted plots except one yellow pine and two Douglas fir for which no additional stock was obtainable. In the fall, one more plot of Douglas fir grown from Pocatello seed and representing the Great Basin was planted, and seedling stock was obtained of Douglas fir from Snoqualmie (W. slope Cascades) and yellow pine from Ashley (Utah) seed and transplanted to the nursery for one more years growth before field planting.

Measurements of total height and season's growth were made on all field plots in October. Some interesting

differences in growth have shown up the second season. In general those lots from southern seed, California, Arizona, Colorado, etc., have made noticeably greater growth and are stockier, sturdier plants than those from northern sources. All of the different plots appear to be hardy in this climate after the roots are once established. Most of the loss the second season was due to the attacks of burrowing rodents, which in several cases bit the plants off near the surface of the ground or buried them in their mounds.

Further Work Planned.

This is a long-term and continuous project involving the establishment of representative plots and periodic comparisons of growth until such time as the merits of stock from each source are fully established as far as planting in this region is concerned. It will be possible to complete the establishment of the necessary plots during the next two years. After that only observations and replanting of fail places will be necessary.

In addition to the specific work on this project it will be possible to make observations on growth on plots installed in connection with other projects. This includes yellow pine from the Bitterroot and Idaho Forests, white pine from the Lolo, Coeur d'Alene and Idaho Forests, and western larch from the Lolo and Blackfoot Forests.

5. Project Fn-2, D-1, Priest River

Title BEST SEASON FOR SEED SOWING
Western White Pine
Western Yellow Pine

Work Previous to 1913:

One 4x12 bed was started at the Benton Nursery for each species in the fall of 1911; one-third bed sown in fall and two thirds the following spring. Results indicated that fall sowing was best for white pine and spring sowing best for yellow pine. One 4x12 bed was sown to white pine, fall 1912.

Work Done in 1913:

Early spring observations on the white pine bed sown in the fall of 1912 showed that the mice had followed along the drills and eaten up most of the seed in spite of protective screens. No spring sowing was done therefore, since value of comparison was destroyed by this factor. Close observations, to represent results of late spring sowing, were made on three 4x12 beds of yellow pine sown June 6, in other experiments.

November 13 two beds were sown with yellow pine, one in drills and the other broadcast, to be compared with yellow pine to be sown next spring. No white pine seed was available for fall sowing.

Further Work Planned.

Work should be continued from year to year as opportunity offers until definite results have been obtained for each species regardless of source of seed and other factors.

6. Project Fs-3, D-1, Priest River

Title DEPTH OF COVERING SEED
Western white pine
Western yellow pine
Western larch

Work Previous to 1913:

One 4x12 bed was sown to white pine and one to yellow pine in fall 1911, each 1/6th bed sown at a different depth from 1/4" to 1 1/4", in unwatered nursery under rather poor conditions and results were not conclusive. Yellow pine sown at 3/4" and 1/2" and white pine at 1/2" and 1/4" in project Fs-2, at Savenac, Boulder and Priest River nurseries in spring, 1912. After the 1913 counts were made, germination record showed:

		Savenac	Priest R.	Boulder	Average
Yellow Pine	1/2"	50.6	41.4	31.8	41.0
" "	3/4"	48.6	40.8	27.2	38.9
White Pine	1/4"	22.4	28.4	19.0	23.2
" "	1/2"	48.8	26.8	19.0	31.5

The difference in the two depths of yellow pine is slight but consistently favors the lesser depth of 1/2 inch. The wide difference in the white pine at Savenac is surprising and must have been partially due to other causes, since the other two nurseries show almost no difference. If the Savenac results were barred out, the 1/4" would be slightly favored. The larch plots in this experiment showed a fairly marked difference in favor of 1/4" over 1/2".

One bed was sown to white pine in the fall in 1/8" variations from 1/4" to 3/4".

Work Done in 1913:

Early spring observations on white pine bed showed that mice had eaten a large part of the seed and the results were therefore rendered useless. Nothing more was done with white pine because of lack of necessary seed and because more information was needed on white pine germination.

One bed was sown to yellow pine and one bed to larch, June 6, 1913. Half of each bed was in drills and half broadcast and each half divided into six plots covered with sand to different depths from 1/4" to 1". Germination is shown in following table:

Species	Depth	Sown in Drills		Sown Broadcast	
		Germination	Survival	Germination	Survival
Yel. P.	1/4"	714	546	702	560
" "	3/8"	577	456	776	645
" "	1/2"	656	507	565	482
" "	5/8"	505	302	733	500
" "	3/4"	449	293	694	438
" "	1"	366	237	621	449
W. Larch	1/4"	973	858	1110	843
" "	3/8"	1234	1027	909	679
" "	1/2"	1134	802	1033	802
" "	5/8"	724	448	596	323
" "	3/4"	692	337	828°	526
" "	1"	432	182	172	97

°Depth in this case reduced to 1/2" by washing.

Germination and survival for both species were in general much better for the lesser depths. For yellow pine 1/4" and 3/8" are best and about the same while figures for 1/2" and 5/8" are uniform and somewhat lower. With the larch, the depths from 1/4" to 1/2 inch outclassed the deeper ones but showed little difference among themselves. An important point brought to light is that the percentage of death from damping off increases rapidly with the depth, so that at the deeper depths there is not only less germination than at shallower depths, but in most cases a much larger per cent of those germinated fail to survive.

Numerous cultures and close observations showed that this failure to survive was due almost entirely to damping off fungi, so that we can conclude that deep sowing favors their activity.

All of our results favor a depth from 1/4" to 1/2" of clean sand, with small distinction between them, for the three species involved in this study. Since slight variations in depth will occur in practice a standard of 3/8 inch appears best for these three species. Variation of 1/8" either way from this standard will thus not affect the uniformity of the germination materially. This depth was used in the two beds sown in November with yellow pine.

Further Work Planned.

Our results agree closely with information gained from other investigations with yellow pine and white pine

in favoring a depth of 1/2" or less and under these circumstances it is thought that the study has been conclusive enought to warrant testing out on a larger scale at the regular nurseries, using a standard depth of 3/8". Therefore no further specific work on this project is planned at the Experiment Station until the results of such tests are known.

7. Project Fn-4, D-1, Priest River

Title _ BROADCAST VERSUS DRILL SOWING IN THE SEEDBED

Western White Pine
Western Yellow Pine
Douglas Fir
Western Larch

Work Previous to 1913:

One 4x12 bed was sown to yellow pine and one to white pine, half in drills and half broadcast, partly in the fall of 1911 and partly in the spring of 1912. Beds were unwatered and conditions poor so that results were not conclusive. Very little difference was shown.

Work Done in 1913:

A small study was made of the development of 1-year white pine seedlings raised in drills at the Savenac nursery, sown in fall of 1911. Sample seedlings were taken at points where the density in the row was (1) less than one per inch, (2) five per inch, (3) ten per inch and (4) 15 per inch and photographed to show comparative development. Object was to show number of seedlings of proper development which could be raised in a uniform drilled bed. It is hoped to carry this study further and on a larger scale and to follow the seedlings through transplanting and field planting.

One 4x12 bed was sown to yellow pine and one to western larch June 6, 1913, half of each bed being in drills 3 inches apart and half broadcast. Each half was divided into six plots sown at different depths as noted under project Fn-3. Half shade was given during the season and beds

were watered regularly. Germination was completely counted at intervals of one week during active germination and two weeks at other times. The month in which the seedlings sprouted was indicated by colored toothpicks. Cultures were made of dead seedlings which indicated that practically all loss was due to damping off fungi. The table shows results:

Depth of Cover:	Germination in Drills: Total: No.	% total occurring: June	July	Aug.Sep:	Germination in Broadcast: Total: No.	% total occuring in: June	July	Aug. :Sep.:
Yel.P. 1/4"	714	48.7	10.8	40.5	702	45.0	16.1	38.9
3/8"	577	45.4	13.2	41.4	776	42.5	14.7	42.8
1/2"	656	44.4	9.3	46.3	565	41.9	15.9	42.2
5/8"	505	47.9	12.1	40.0	733	45.4	15.0	39.6
3/4"	449	42.1	8.7	49.2	694	43.5	14.5	42.0
1"	366	34.1	10.7	55.2	621	34.8	15.3	49.9
Aver. Yel. P.	545	43.8	10.8	45.4	682	42.2	15.2	42.6
Larch 1/4"	973	0.3	17.5	82.2	1110	0.3	13.3	86.4
3/8"	1234	0.2	10.2	89.6	909	0.2	6.5	93.3
1/2"	1134	0.0	5.7	94.3	1033	0.0	5.2	94.8
5/8"	724	0.0	0.1	99.9	596	0.0	2.5	97.5
3/4"	692	0.0	0.0	100	828	0.0	2.8	97.2
1"	432	0.0	0.0	100	172	0.0	0.0	100.0
Aver. Larch	865	0.1	5.6	94.3	775	0.1	5.0	94.9

In the first three depths, the yellow pine broadcast has only a slight advantage over the drills in number (400 per bed) but this rapidly increases with the greater depths making

a total average difference of 1600 per bed in favor of broadcast sowing from the same amount of yellow pine seed.

The larch in numbers shows a marked advantage of about 1100 per bed, throughout, in favor of drill sowing. Retarding of germination due to increase in covering shows distinctly at 3/4" and 1" with the yellow pine and at all depths after 1/4" with the larch. Germination progressed very uniformly with both species, there being practically no difference in rapidity between the broadcast and drill sown plots. The following table compares the survival:

Depth of Cover	Seedlings in Drills: No. Germ	Surviving: No.	Surviving: %	% of dead damped off	Seedlings Broadcasted: No. Germ	Surviving: No.	Surviving: %	% of dead damped off
Yel.P.								
1/4"	714	546	76.5	98.0%	702	560	79.8	100%
3/8"	577	456	79.0	100%	776	645	83.1	100%
1/2"	656	507	77.3	100%	565	482	85.3	100%
5/8"	505	302	59.8	100%	733	500	68.2	100%
3/4"	449	293	65.2	100%	694	438	63.1	100%
1"	366	237	64.8	100%	621	449	72.3	100%
Aver. Yel.P.			70.4	99.7%			75.3	100%
Larch								
1/4"	973	858	88.2	100%	1110	843	75.9	100%
3/8"	1234	1027	83.2	100%	909	697	76.7	96.7%
1/2"	1134	802	70.7	100%	1033	802	77.6	100%
5/8"	724	448	61.9	100%	596	323	54.2	98.5%
3/4"	692	337	48.7	100%	828	526	63.5	100%
1"	432	182	42.1	100%	172	97	56.4	100%
Aver. Larch			65.8	100%			67.4	99.2%

Survival of broadcast yellow pine is slightly but uniformly better than in drills and that of broadcast larch is very slightly better in the aggregate than in drills. In general this seems to indicate that the fungi are able to work to better advantage along the drills where the seedlings are close together and in a uniform stand, although the larch at 1/4" and 3/8" does not bear this out. The advantage in favor of the broadcast is so slight in this respect that it need not carry much weight in deciding the merits of the two methods.

Further Work Planned

The study as far as it has gone seems to indicate that broadcasting of yellow pine and drill sowing of larch are preferable on a basis of germination and survival. Next spring at time of transplanting a comparative study of development and density will be made which will throw more light on the matter. To carry the work further, two beds were sown to yellow pine November 13, one in drills and one broadcast at a uniform depth of 3/8". This will be drplicated in the spring and records taken for a second growing season. As a check on larch, one bed will be put in next spring, half drills and half broadcast. Nothing more can be done with white pine until seed can be secured. Also more information is needed on white pine germination before starting extensive experiments with that species.

Project Fn-6, D-1, Priest River

Title: VALUE OF DIFFERENT DEGREES OF SHADING IN GROWING NURSERY STOCK

Western Yellow Pine
Western White Pine
Douglas Fir
Western Larch

Work Previous to 1913:

No direct investigative work.

Work done in 1913:

With the present practice of using half shade on practically all species during the first year as a starting point, an experiment was put in with yellow pine, larch, and douglas fir. No white pine was used for lack of seed and lack of sufficient knowledge of white pine germination. Two beds were sown broadcast, 1/3 of each to each of the species used. Bed No. 5 was given no shade during any part of the season. Bed No. 6 was shaded 1/4 by ripping lath in halves and placing the strips 1½ inches apart on the frame. Seedlings of each species were produced under half shade in experiments under other projects for comparison with no shade and quarter shade, using same kind and amount of seed. The results will be discussed by species:

A. Western Yellow Pine

Shading	Germination in % seed sown				Survival % seed sown
	June	July	Aug-Sep	Total	Total
None	48.7	30.8	20.5	87.0	82.0
Quarter	56.8	34.4	28.8	67.0	52.0
Half	41.9	15.9	42.2	38.0	32.0

All variables except the degree of shading were practically absent from this experiment and the comparison given in the table is considered accurate. The plot having no shade makes much the best showing and that with quarter shade is just about intermediate. The very wide differences shown here under otherwise uniform conditions seem to show clearly that for the Priest River nursery yellow pine should not be shaded at all. A much higher germination, a much smaller loss, and an earlier germination seem to result from this method of handling, provided artificial watering is used.

B. Douglas Fir

Shading	Germination in % seed sown				Survival in % sown
	June	July	Aug-Sep.	Total	Total
None	0.0	47.7	52.3	74.0	70.0 (sown 6/6)
Quarter	0.0	41.9	58.1	92.0	90.0 do
Half	84.2	3.2	12.6	84.0	76.0 (sown 5/1)

In this case the half shaded bed was sown five weeks earlier than the others and the progress of germination must therefore be thrown out of the comparison.

The germination seems to have been slightly but not seriously retarded under quarter shade in comparison with no shade. The quarter shade shows, however, a distinct advantage over the other two in having the largest germination combined with the smallest loss. From these results the obvious conclusion is that quarter shade will give best results with Douglas fir at the Priest River nursery, with half shade second and no shade in third place.

C. Western Larch

Shading	Germination in % seed sown: June	July	Aug-Sep	Total	Survival % sown: Total	Date Sown
None	0.0	14.7	83.3	3.9	1.8	6/6
Quarter	0.0	6.1	93.9	8.7	4.6	6/6
Half	0.0	5.2	94.8	13.0	10.0	6/6
Half	63.0	7.7	29.3	24.0	14.0	5/1

The first three plots represent identical conditions with the exception of shading. The last was sown five weeks earlier but was handled in about the same way otherwise, except that it was covered 1/4" deep instead of 1/2". In this case the combination of early sowing and light covering seems to have an advantage over late sowing and heavier covering. In regard to shading, the differences are shown up very clearly. Both of the half-shaded plots proved much better than the other degrees, with quarter shade intermediate and no shade practically a fail-

ure. An interesting point here is that almost exactly half of the few seedlings found on the bed not shaded were growing under what amounted to half shade in a strip 6" wide in the shade of the side bar of the protective frame and most of the others were found close to the west edge in the shade of the end bar. Germination was very ppor in the direct sun and the seedlings seemed unable to survive after having germinated.

The experiment shows beyond doubt that larch seedlings require shade and that half shade gives the best results of the three degrees tried, under the conditions at Priest River.

Further Work Planned:

Next spring at time of transplanting, records and measurements will be made of representative seedlings growing under the various degrees of shade to supplement the record of germination and survival. It is felt, however, that even if these later figures check closely with the first ones, the experiment should be repeated for at least another season in order to be conclusive.

It is therefore planned to install a similar experiment in 1914 using about the same amount of space as in 1913 with possibly some intermediate degrees of shading included. Sowing will be done as early as possible and the depth of covering determined in Project Fn-3 will be used.

Project Fn-7, D-1, Priest River

Title: EFFECT OF WATERING AND CULTIVATION UPON GROWING PLANTING STOCK

Western Yellow Pine
Western White Pine
Western Larch

Work Previous to 1913:

No direct investigative work.

Work Done in 1913:

Three 4x12 beds were sown in drills, using western larch and western yellow pine. Larch was substituted for white pine because of lack of seed and lack of information on white pine germination. Half of each bed was used for each species. Drills were 3 inches apart so as to represent one square foot of area. The plan was to handle all three beds in a similar manner during germination and until the stand was fairly well established and then to differentiate by giving one cultivation and no water, one cultivation and 2 quarts water per square foot every 4th day, and the third no cultivation with 1 quart water every second day. Half shade was provided during the season except when removed occasionally to check damping off. A covering of 1/2 inch of sand was used on all beds.

Owing to the late sowing (June 6), germination was slow and the stand was not considered suitable for the experiment until August 27. From that time during the rather dry month of September until October 4, for 5½ weeks, the plan was followed as specified. Results will

be discussed by species:

A. Yellow Pine

No essential differences in germination and survival due to treatment were brought out. About 40% of the germination occurred in August and 5% in September which shows why it was thought necessary to delay the treatment until late in August. The per cent of germination was 34% in two of the beds and 42% in the other. Per cent of loss was about the same, -- from 33 to 36% of germination, due almost entirely to damping off, which was serious in the beds during July and August,--another reason for delaying the watering treatments. Final stand per drill was 81, 99, and 115 for the various beds.

B. Western Larch

The larch plots showed no difference from the treatment as far as germination and survival were concerned. Over 96% both of germination and loss occurred during August. Loss varied from 35 to 45 per cent, due to damping off. Very little water was given in August, in order to check this trouble as much as possible. Final stand per drill was 117, 153, and 173 for the three beds.

Further Work Planned.

Since it took almost the entire growing season to establish a stand before differentiation in treatment could start, it seems doubtful whether such an experiment

can be confined to the first year beds, with much hope of showing important differences resulting from these treatments. As far as first year beds are concerned it has been found so universally true that watering during dry periods benefits both germination and growth, that further investigation of its value seems of minor importance. It is felt, however, that in raising two-year seedlings, cultivation without artificial watering may give to the plants a better development or make them hardier for field planting than would frequent watering without cultivation.

It is therefore planned to continue the three beds through a second season with treatment differing throughout the period as follows: (1) cultivation with no watering, (2) cultivation and normal amount of water given half as often as on ordinary beds, (3) no cultivation but with the normal amount of water as given other beds. The normal amount is estimated from this year's experience to be about 1 pint per square foot or 6 gallons per bed, this being about all that the soil will absorb at one time without cultivation. Rains of any consequence will be considered as a watering. Part of the 2-0 seedlings will then be planted and part carried one year in transplant beds and then field planted if important differences show up in the results of different treatments given seed beds.

In connection with this study a record is being kept, showing the amount and intervals of water applied to all nursery beds and transplant beds so that the general

results over a series of years of certain methods of watering will be known.

Project Fn-8, D-1, Priest River

Title: METHODS OF CONTROLLING DEVELOPMENT OF THE ROOT SYSTEM OF PLANTING STOCK

Western White Pine
Western Yellow Pine
Western Larch

Work Previous to 1913:

No definite investigative work.

Work Done in 1913:

One bed of fall sown 1-year old yellow pine in drills 6-inches apart was used in a root-pruning experiment. Half of bed, containing 12 drills, was pruned about six inches below the surface by cutting the roots with a sharp spade, July 7, to show the result of late spring work of this kind. Nine pruned and 1 unpruned died during season. The lower leaves of pruned seedlings showed tendency to turn brown. Height growth was mostly finished at time of pruning. Next spring, when seedlings are taken up for planting, measurements and records of development will be taken.

In May, while transplanting 1-year fall sown yellow pine grown in broadcast bed, 1107 were not pruned and 2142 were pruned at a point 4½ inches below the first lateral. The upper root from the ground line to first lateral varied from .8 to 6.0 inches and averaged 2½ inches. This would make total length of pruned root average 7 inches. Survival count was made in November and record of development will be made at time stock is dug for planting, after the season of 1914.

Further Work Planned.

In the first experiment, planted plots will be established in the spring of 1914 to show difference between pruned and unpruned stock for field planting. In thesecond experiment transplants will be left until spring of 1915 and field plots established to show planting value.

In connection with the transplanting to be done in the spring of 1914, an experiment will be established to compare the effect of frequent light waterings and infrequent heavy waterings on root development of yellow pine stock. As soon as 1-year yellow pine in drills is available, part will be pruned in the beds with spade in the fall and part in the early and late spring following to be developed into 2-0 stock. This will probably be started fall of 1914.

Project Fp-1, D-1, Priest River

Title: TESTS OF SPECIES NOT NATIVE TO WESTERN PART OF DISTRICT ONE

(Hardwoods)	(Conifers)
Basswood	Norway Spruce
White Ash	Sugar Pine
Shagbark Hickory	Eastern White Pine
Red Oak	Norway Pine
Burr Oak	Incense Cedar
Black Walnut	Scotch Pine
White Elm	Austrian Pine
Hard Maple	European Larch
Black Locust	Japanese Larch
Pignut Hickory	Bigtree
White Ash	Limber Pine
Black Oak	Colorado Blue Spruce
Soft Maple	American Arbor Vitae
Butternut	Chinese Arbor Vitae
American Beech	Concolor Fir
European Beech	
American Chestnut	
White Oak	
Sycamore	
Swamp White Oak	

Work Previous to 1913.

Planting plots on suitable sites established with 50 to 100 of first eleven hardwoods (to white ash) and the first ten conifers (to Bigtree) with records of growth and survival.

Work Done in 1913:

Balance of species listed, 9 hardwoods and 5 conifers, were planted in the fall, using from 50 to 100 of each. Seedlings of some other hardwoods were raised in nursery but are too small to plant until after one or two more years in nursery. Fifty-six separate experimental units are now installed in the field.

Further Work Planned:

Stock now in the nursery will be planted when ready and possibly a few other species will be added from time to time but installations are now practically complete and further work will consist largely of observations on present plantations. Field tests of the more promising species will be undertaken, on a larger scale on planting projects in cooperation with the Section of Planting.

Project Fp-2, D-1, Priest River

Title: COMPARISON OF DIFFERENT CLASSES OF STOCK

Western White Pine
Western Yellow Pine
Western Larch
Douglas Fir

Work Previous to 1913:

In spring 1912, 100 each of 1-0, 2-0, 1-1, and 2-1 yellow pine were planted. In the fall 100 each of five classes, 1-0, 2-0, 1-1, 2-1, and 1-2, were planted. Three classes of larch, 100 of each, 2-0, 1-1 and 2-1, were planted spring of 1912 and 100 each of two classes, 3-0, and 2-2 in the fall. Three age classes of white pine, 100 of each, 2-0, 1-1, and 2-1 were planted in the fall of 1912. An experiment was also started in the fall of 1912 with two plots of 100 of 2-1 white pine, one root pruned and the other not pruned.

Work Done in 1913.

In the spring 100 1-0 white pine were planted in the age class study. In the fall, four plots of 400 each were planted to 1-2 white pine representing different quality classes into which 1700 of general run stock from the nursery were sorted,-- large, medium with well developed roots, medium with poor roots, and small. 1600 1-2 yellow pine were sorted into size classes, large, medium and small, and 400 of each class were planted in three plots in the fall. Also 400 2-0 and 400 1-1 yellow pine grown at the Station were planted in the age class study.

Results to Date:

Yellow Pine age classes in Block A after two seasons (planted spring 1912) show following comparison:

Age	No. Used	Survival % 1912	Survival % 1913	Loss in % Total	Loss in % Rod.	Average 1913 Growth	Average 1913 Height	Cost M.	Surv. Seedl.
*2-1	100	93	91	9	2	4.6	7.9	$6.91	.0076
1-1	100	79	78	22	16	2.5	6.0	4.54	.0052
2-0	100	68	65	35	24	2.3	5.0	2.06	.0032
1-0	100	81	69	31	15	1.6	3.3	1.88	.0027

*All stock is from Helena seed, raised at Boulder Nursery. The best showing, regardless of cost, is in the order given in table, but with cost per surviving seedling as the basis of comparison, the order is just reversed. Considering the fact that the 2-0 suffered more heavily from rodents than the others and is making better growth than the 1-0 with about the same cost it seems to have the advantage when all points are included. Further differences in survival may show up later.

Yellow Pine Age Classes in Block B (Fall, 1912)

Age	Source: Seed	% Survival 1912	% Survival 1913	Loss Rod.	Average - 1913 Growth	Average - 1913 Height	Costs at Nursery per M	Surv. Seedl.
2-0	Bitterrt	100	93	3	1.8	4.2	2.91	.0031
1-0	"	100	91	4	0.7	2.6	1.65	.0018
1-2	Helena	100	79	2	1.0	4.0	4.65	.0059
2-1	"	100	78	6	0.4	3.5	3.27	.0042
1-1	"	100	77	3	0.2	2.8	3.27	.0042
1-1	Idaho	100	71	3	0.5	2.2	3.27	.0046
2-1	Idaho	100	61	7	0.5	2.8	3.27	.0054

All stock raised at Savenac Nursery

Here the seedling stock (1-0 and 2-0 from Bitterroot seed) has outclassed the transplants not only on a basis of

cost but also in total survival and growth, for the first year in the plantations. Conditions of the site were quite uniform in the various plots.

Larch Age Classes, spring and fall, 1912:

Age	Source of Seed	Nursery	Survival % 1912	Survival % 1913	Loss: Rod.	Average for 1913 Growth	Average for 1913 Height
2-0	Lolo	Boul	76	72	10	3.0	11.5
2-1	"	"	52	50	7	1.1	5.4
1-1	"	"	29	23	13	1.3	3.1
Fall							
3-0	Blackft	Sav.	100	71		2.6	5.9
2-2	Lolo	"	100	70		1.9	7.3

The interesting thing brought out in this experiment is the superiority of seedling stock over transplants under the climatic conditions of 1912 and 1913, not only from the standpoint of survival and growth but also of cost, since the cost of seedlings is always materially less than transplants. Fall planting of larch appears better than spring planting although the comparison is not exact.

White Pine Age Classes, fall, 1912, spring 1913.

Age	Source of Seed	Nursery	No. Used	Living F-1913	Loss from Rod.	Loss from Cattle	Average - 1913 Growth	Average - 1913 Height
Fall								
2-0	Lolo	Sav.	100	85			1.2	2.8
2-1	Idaho	Sav	100	67	1	3	0.7	2.3
1-1	"	Sav	100	64	1	6	0.7	2.3
Spring								
1-0	Lolo	P.R.	100	89	1			1.4

Here again the seedling stock appears better than the transplants on every score, after one season. The 1-1 transplants made about the same record as the 2-1 stock. Source of seed may be a partial cause of the differences.

Summary:

Uniformly for all species and on favorable as well as severe sites, seedlings have made a better showing than transplants, both for fall and spring planting. Moisture conditions have been favorable both seasons, however, so that this might not hold true during dry seasons. However, if the transplants possessed the property of surviving better in dry seasons than seedlings, it seems reasonable to think that they would do at least as well as seedlings in favorable seasons.

Further Work Planned

The work so far cannot be considered conclusive both because of the small number of plants used and because the average results of experiments extending over a period of years will alone justify drawing definite conclusions. Observations will be kept up on the experiments already started and further work will be done with the principal age classes, including 2-0, 1-1, 1-2 and 2-1. In all future work, 400 of each kind will be used as in the experiments started this fall. Actual installation of new experiments will depend upon when the proper stock is to be had at the nurseries and upon the time and space available for such work.

The experiments in quality of stock started with the intention of finding the value of culling and of carrying small stock over for another year in the nursery, as well as to find the best size and development to strive for

in nursery work, will be repeated next spring with white and yellow pine and more experiments started when opportunity offers.

Project Fp-3, D-1, Priest River

Title: SEASON FOR SOWING AND PLANTING

Western White Pine
Western Yellow Pine
Western Larch
Douglas Fir

Work Previous to 1913:

As reported in the 1912 annual report, planting and sowing was done with white pine, yellow pine, and Douglas Fir in the fall of 1911 and spring of 1912 and larch was planted in the spring of 1912. The following table shows results:

Species	Block*	Best Season Indicated For		
		Planting	Broadcast	Seedspots
Yellow Pine	A	Spring	Fall	Spring
" "	B	Fall	Fall	Fall
Douglas Fir	A	Fall	Spring	Fall
" "	B	Fall	Fall	Fall
White Pine	C	Spring	Fall	Fall

*Block A,--Sandy Flat; Block B,--S.W.Slope;Block C,--Flat

The units in this work were 100 plants or spots in a plot 50 feet square. This number is thought to be too small to base final conclusions upon, and in any case extension of work over several seasons is considered necessary as a check and to strike an average.

In the fall of 1912, white pine, yellow pine, and larch were planted and white pine sown.

Work Done in 1913.

In the spring, 100 1-0 white pine were planted, seedspots were sown with white pine, yellow pine and Douglas Fir, and larch seed was sown broadcast, with corn-planter, and in seedspots.

In the fall, planting was done with 2400 1-2 white pine, 1200 1-2 yellow pine, 400 2-0 yellow pine and 400 1-1 yellow pine. Larch seed was sown broadcast, with cornplanter, and in prepared and unprepared seedppots.

Results to Date:

1. White Pine Seasonal Success

Method	Site	Fall-1911 Used	Fall-1911 Surv	Sprg-1912 Used	Sprg-1912 Surv	Fall-1912 Used	Fall-1912 Surv	Sprg-1913 Used	Sprg-1913 Surv	Best Season
Planting	C	200	57%	200	60%	1200	92%	100	89%	Fall
Seedspots	C	100	21%	100	41%	200	60%	100	5%	Fall
Cornplanter	C	100	11%	100	5%	200	7%			Fall
Broadcast	C	2/17	17°	2/17	187°	1/4	232°			Fall

° Number of seedlings per acre and number acres used

2. Yellow Pine Seasonal Success

Method	Site	Fall-1911 Used	Fall-1911 Surv	Sprg-1912 Used	Sprg-1912 Surv	Fall-1912 Used	Fall-1912 Surv	Sprg-1913 Used	Sprg-1913 Surv	Best Season
Planting	A	100	47%	500	75%					Spring
	B	100	55%	200	32%					Fall
Seedspots	A	100	35%	100	63%			200	78%	Spring
	B			100	49%			100	0%	Spring
Cornplanter	A	100	13%	100	19%					Spring
	B	100	13%	100	2%					Fall
Broadcast	A	1/17	731°	1/17	313°					
	B	1/17	0°	1/17	17°					

° Number per acre and acreage used.

3. Douglas Fir and Western Larch Seasonal Success.

Method	Site	Fall-1911 Used	Fall-1911 Surv	Sprg-1912 Used	Sprg-1912 Surv	Fall-1912 Used	Fall-1912 Surv	Sprg-1913 Used	Sprg-1913 Surv	Best Season
Douglas Fir										
Plant.	A	100	69%	100	74%					Fall
	B	100	74%	210	45%					Fall
Seedspots	A			100	79%			200	42%	?
	B			100	51%					?
Cornpltr	A	100	35%	100	18%					Fall
	B	100	10%	100	3%					Fall
Broadcast	A	1/17	174°	1/17	2956?					Spring
	B	"	0	"	0					?

° No per acre

Larch										
Planting	A			300	48%					
	B			50	14%					
	C			50	26%	200	71%			Fall
Seedspots	A							100	0%	
	C							100	0%	
Cornpltr	A							100	0%	
	C							100	0%	
Broadcast	A							1/17	17°	
	C							1/17	0°	

° Number per acre.

The best season as shown in the tables is quite certainly fall for planting larch and for sowing white pine, but the others are open to further proof.

Further Work Planned.

As opportunity offers, in connection with the Fp-2 and Fp-5 projects, planting and sowing of the differnet species will be done and the results worked up to show comparison of seasons. No individual work on this project is recommended except insofar as it fits in with the other

projects.

Project Pp-4, D-1, Priest River

Title: METHODS OF SOWING AND PLANTING

Western White Pine

Object: To determine for the various sites the best compositions and spacings for both plants and seed spots of western white pine and other species.

Work Done Previous to 1913:

No direct work on this project but two plots were established containing 50 plants each of white pine and western larch spaced 5x5 in alternate holes, assigned to the project on sites, No. Pp-6.

Work Done in 1913:

No direct work on this project by the Experiment Station. In view of the importance of starting plantations to show the effects of different spacings and mixtures, the Section of Planting in the District started some experiments on a large scale on the Placer Creek planting area on the Coeur d'Alene Forest in May, 1913, using yellow pine and Douglas Fir spaced a t a number of different intervals. This work can be considered an integral part of this project.

Further Work Planned:

Limits of space and time at the Experiment Station make it doubtful if many plantations suitable for this project can be established there. Much better results can be secured by such work as that installed at Placer Creek. It is felt therefore that direct work on this project by the

Station should be limited to co-operation with the Section of Planting in the preparation of working plans and working up of results.

Project Fp-5, D-1, Priest River

Title: METHODS OF SOWING AND PLANTING

Western White Pine
Western Yellow Pine
Western Larch
Douglas Fir

Object: A comparison of methods used in reforestation.

Work Previous to 1913:

Fifty-four separate plots or experimental units were installed. Forty-six of these were reported upon in the 1912 report, the remaining eight having been installed in the fall of that year. By species, these included 16 yellow pine, 15 Douglas Fir, and 23 white pine.

Work Done in 1913:

Twenty-three additional units were installed in the spring and fall, including 6 yellow pine, 4 Douglas Fir, 2 white pine and 10 larch. Previous work covered the comparison of planting by cone, slit and side of hole methods on different sites with sowing in cornplanter and prepared seed spots and broadcast sowing, most of the work having been repeated for two or more seasons.

This work had shown that seedspots were the best method of sowing but that rodents were an important factor. Several plots were therefore sown in the spring to test out the efficiency of placing small squares of 3/4" mesh poultry netting above the seed and covering both with earth, in preventing the rodents from getting at the seed. All four species were used in this series.

In the case of larch, broadcast and cornplanter sowing was done for the first time in the early summer to be compared with seedspots, and was repeated in the fall. In the fall two plots of 1-2 white pine were planted, each containing 400, one planted by slit method and one by the side of hole method. A slightly different method called "prepared side of hole" was used with similar stock in project Fp-2 for comparison.

Results:

Space does not permit detailed tabulation of results at this time but they will be included in the complete progress report to be issued later this winter. The principal points, brought out so far in the study, follow;

1. Planting and sowing in prepared seedspots have clearly outclassed cornplanter sowing and broadcast sowing in producing results and it is felt that work with the two latter methods may be largely terminated with the exception of repeating the larch sowing experiments early next spring.

2. Although planting has in general produced somewhat better results than seedspot sowing in survival, the latter method is cheaper and in the matter of cost per living seedling compares favorably with planting. Much more work can be done along the lines of developing faster methods of seedspotting and of discovering the best preparation of the ground under different conditions and for different species.

3. The early work in methods of planting in comparing slit and cone on a basis of 100 plants was not conclusive. The 2-1 white pine planted fall of 1912, 400 by each of three different methods under very uniform conditions, gave interesting results, shown in table:

Comparison of Methods of Planting White Pine.

Method	Per Cent Survival	Growth 1913	Rate per man pr day	Cost labor per survival	No. Used	No. Surv.
Side hole	96.0	.5"	640	4.9¢	400	384
Cone	90.8	.4"	400	8.6¢	400	363
Slit	89.5	.8"	850	3.9¢	400	358

The survival in these plots was remarkably similar and shows that when conditions are favorable the method used in packing soil around the roots does not make an essential difference as long as soil is moist and mellow and care is taken in setting and firming the plant. The average growth was based on actual measurement of about 15% of the plants and indicates that the slit planted stock has taken hold well.

Since all other costs are uniform, comparison can be made on a basis of a labor cost figured at $3.00 per man per day. This of course gives a decided advantage in favor of the cheapest and fastest method. In this experiment, the lifting of the dirt from the hole as in the cone and side of hole methods, and manipulation of dirt with hands as in the cone method were practically wasted as far as

results were concerned. It appears, therefore, that for fall planting on favorable sites under careful supervision, a well made slit serves as well as more careful methods at much smaller cost.

4. In the experiment in using wire netting as protection against rodents, the netting succeeded very well in discouraging the animals. They would dig down until they came to a wire and then stop and try some other place. In eliminating the rodents, however, another trouble was encountered in that many of the sprouting seeds in coming to the surface were caught and held down by the wire mesh. This proved a much more serious factor than rodents since the check plots with both Douglas Fir and yellow pine showed twice as much germination and survival as those covered with wire.

	Cover	Success in Per Cent spots	
		Germination	Survival
Yellow Pine	Wire	43%	40%
do	No wire	80%	78%
Douglas Fir	Wire	25%	20%
do	No wire	48%	42%

The use of the wire screens must therefore be considered a definite failure.

Further Work Planned.

Study of the details of methods of planting and of making seed spots will be continued with the aim of eliminating waste motions and finding that method which

best combines a high degree of success with speed, on various sites and under different conditions. Experiments will be made with different tools and labor saving devices in this connection. It is planned to terminate broadcast and cornplanter work after the larch sowing next spring.

Project Fp-6, D-1, Priest River.

Title: STUDY OF SITES
Western Yellow Pine
Western White Pine
Western Larch
Douglas Fir

Work Previous to 1913:

This project and also the project on Season for Planting, Fp-3, are so closely allied with project Fp-5 that it is impossible to keep records and costs separately. Many of the experimental units serve for all three projects. Therefore, since project Fp-5 is considered the most important one, most of the common costs and records have been given its designation with the idea of working up data on seasons and sites from the Fp-5 records. Wherever any units were not concerned with the study of methods, however, they have been assigned to one or other of the other projects. Thus the only units assigned to Fp-6 are two plots, one on Block B and the other on Block C, planted alternately with white pine and larch, solely for comparison of sites.

In connection with the other projects, however, a comparison has been made between blocks A and B for Douglas Fir and Yellow Pine, Blocks A, B, and C, for larch and Blocks B and C for white pine.

Work Done in 1913:

None except connected with Projects Fp-2 and Fp-5.

In connection with project Fp-2, 800 1-2 white pine were planted in Block C and 1600 in Block A, in October.

In Fp-5, larch was sbwed by three methods in Blocks A and C in the spring.

Results to Date:

Block B, the southwest slope is distinctly the least favorable site with the exception of one instance in which 50 2-1 white pines show, after two seasons, a survival of 90% which compares favorably with anything on the supposedly most favorable Block C. Individual differences of this kind are bound to occur, however, due to condition of stock, etc. One thing shown is that white pine can be planted with considerable success on south slopes.

Further Work Planned:

It is planned to plant yellow pine and white pine on several other slopes and situations with check plots on the three experimental blocks, as soon as there is opportunity. Such work involves considerable time and expense just at our busiest nursery and planting season and it is not certain how much can be done with the available force. Seed spots will be sown so as to compare different sites, also. Work will be planned with particular reference to the reforestation of the fail places on the Experiment Station territory with a view to bringing timber production up to maximum as soon as possible.

Project Mc-1, D-1, Priest River

Title: EFFECT OF DIFFERENT METHODS OF CUTTING. DISTRICT ONE

Western White Pine
Western Larch
Douglas Fir
Western Yellow Pine
Lodgepole Pine

Work Previous to 1913:

A. Five clear cut areas in white pine type on the Kaniksu Forest were examined by the Experiment Station in such a way as to show the nature of reproduction coming in and the distance that the various species had migrated from the parent trees. Age of seedlings and conditions of habitat were recorded individually. Five permanent plots were established for periodic study of seedling persistence and migration. These areas were confined to the low flats and benches near the river in the Priest River Valley, since no cutting had been done on slopes.

Points Brought out by these studies

1. By furnishing full overhead light to the surface, establishment white pine and larch is encouraged and hemlock discouraged, cedar being present equally in light and shade.

2. Exposure of mineral soil by burning and scratching encouraged cedar and larch and discouraged hemlock, while white pine seemed equally adapted to any soil surface as long as moisture was present.

3. Migration of white pine from parent trees appa-

rently not dependably within reasonable length of time beyond a distance of from two to three chains.

B. Recommendations for different methods of cutting based on general observations were reported by F. I. Rockwell, August 29, 1912, in "Natural Forest Types of the Kaniksu National Forest." All of the types included in this project were taken up at some length. The methods of cutting recommended for white pine type briefly run from clean cutting on northerly slopes with broadcast burning, to shelterwood cutting on southerly slopes with burning in piles. Seed distribution is to be secured from strips, blocks or groups on the various slopes, distance not being specified.

C. Observations on results of clean-cutting in strips at right angles to contours in the white pine type were reported by W. W. Morris in January, 1913,-- "Natural Reproduction on Old Burns and on Clear Cut Timber Sale Areas, Coeur d'Alene National Forest." He found that a good stand of seedlings had been secured on strips 400 feet wide, in three years after cutting. The complete exposure of the ground to light and the removal of the brush and litter by broadcast burning of the brush in windrows, apparently favored the white pine and discouraged the hemlock seedlings, although these conditions also encouraged the coming in of white fir in company with the white pine.

Work Done in 1913:

I. On the Coeur d'Alene Forest.

June 16-24, a short trip of observation was made

on the Coeur d'Alene Forest by W. W. Morris and D. R. Brewster. The special object was to obtain data on the source of the white pine seed which produced the various stands of reproduction on cuttings and burns. Incidentally the distance to which the white pine and other species had migrated was also studied. A detailed report of this trip was submitted August 1, 1913. To summarize the work and results briefly:

1. Areas Covered.--Five Burns, 2 three year burns
1 thirty year burn
1 twenty-five year burn
1 twenty year burn

Four Cuttings, all winter 1909-10 on slopes.

2. Methods Used

Count strips, 1/8th chain wide, were run on one three-year and one thirty year burn and on three of the cuttings and record made of species, age and soil surface individually for each seedling found. Data taken separately for each 33-foot length of strip. Examination of the other areas was confined to a trip over the the ground and general observations.

3. Principal Points brought out by Study

a. Severe 1910 burns on north slopes have not yet started to reproduce even with a stand of seed trees on the upper and windward sides of burned area.

b. A 15 to 25 year stand of white pine, 1/4 mile wide, coming up on a thirty-year burn, was not the result of seeding in from the present standing timber on the side

but was sown largely by scorched seed trees left on the area after the fire which have since been cut or blown down.

c. White Pine seedlings coming up in small openings in mature timber caused by insects, light ground fires, etc., are apt to be too heavily shaded and too dense for good development.

d. White Pine will travel two chains from parent seed trees under most any conditions and often up to three chains. Under exceptionally favorable circumstances it will migrate from 1/8 to 1/2 mile from seed trees but not in sufficient abundance to produce a well stocked stand in a period of twenty years.

e. A heavy stand of white pine seedlings germinated the second and third seasons following a light ground fire which killed a small part of the trees and removed only part of the surface litter.

f. Strips cut on slopes in 1910 on which the brush was burned broadcast or in windrows or piles are reproducing to white pine practically only where the ground surface was not burned at all or was burned lightly enough so that the duff and litter was not destroyed. This in spite of the fact that more than half of the surface was severely burned and none of it was more than three chains from seed trees.

g. A good uniform stand of white pine reproduction, mostly 5 years old, has been established on a west slope cutting made in 1910 where scattered seed trees were left

and the brush was burned in piles.

h. A majority of the seedlings coming up on 1910 cuttings germinated in the spring of 1911 and are growing on unburned surface. There was no seed crop in 1910 and the logical conclusion is that these seedlings must have resulted from the 1909 or some even earlier crop.

i. Good reproduction has been secured during the first three years after cutting with both the clean cut and the scattered seed trees methods at practically all points, and only those points, where no severe brush burning has occurred since cutting, regardless of distance from standing seed trees.

4. Tentative Conclusions Based on these Points.

A. Heavy white pine stands may be cut clean without the necessity of leaving seed trees and with the assurance that reproduction will follow from dormant seed left in the duff, provided:-

(1) That cutting follows closely after a good seed crop.

(2) That the brush is either not burned at all where not heavy or that it is so burned as to cover only a minimum part of the ground surface.

B. On areas where provision must be made for entire or partial reseeding after cutting, best results will be secured in the shortest time by limiting the distance of any

part of the area from seed trees to from two to three chains. Groups of seed trees 50 to 60 feet square and located from three to four chains apart would fulfil these conditions while occupying a minimum area,--from 4 to 5 per cent of the total acreage,-- and involving a minimum investment in seed trees,--less than ten per cent of the volume. It is thought that if the groups were this close together they would not, even though small, be subject to heavy enough windfall to interfere with reseeding the area, although this matter of windfirmness needs much more investigation.

II. On the Kaniksu and Pend O'Reille Forests

During August, September, and October much more extensive studies similar to those made on the Coeur d'Alene in June, were carried on on the Kaniksu and Pend Oreille Forests. A list of areas examined follows:-

1. Areas Covered

Kaniksu Cuttings

1. Fox Homestead, Sec. 34, 58 N, 4 W. 1903-04
2. Prater Homestead, S. 4, 57 N, 4 W, 1903-04
3. Bartlett Homestead, ditto 1907-08
5. Falk Homestead, Sec. 20, 57 N, 4 W, 1903-04
6. Lindsley Bros. S. 28, 57 N, 4 W, 1902-03
7. Jurgens Bros, Sec. 28, 57 N, 4 W, 1911-12-13
8. " " Sec. 20, ditto 1909-10
9. Fidelity Co. Sec. 26, 57 N, 5 W, 1909-10-11-12-13
10. Fidelity Co. Sec. 20, ditto 1907-08

11. Fidelity Co. Sec. 30, 57 N, 5 W, 1911-12-13.

12. Hagman homestead, Sec. 20, do 1911-12

13. Jurgens Bros., Sec. 34, 58 N, 4 W., 1910-11.

14. Gamaer, Sec. 21, 58 N, 4 W, 1910-11.

15. Smith Homestedd, Sec. 20, 58 N, 4 W. 1904-05

Kaniksu Burns

16. 1905 Burn, East side of Upper Priest Lake, a very extensive and severe burn, 5 miles long and one to two miles wide.

Pend Oreille Areas

17. Humbird Lumber Co., Pack River, Sec. 3, 59 N, 2 W, 1907-8

18. do do Sec.34, 60 N, 2 W, 1907-8

19. do do Sec.33, do 1908-9

20. 1904 Burn, Ground Fire, do do do 1904

2. Methods Used

Examination was made of representative parts of each area, by means of the standard 8½ foot count strips on which every seedling was counted with age and notes as to habitat. Strips were so placed as to show migration of seed out from seed trees and each chain length of strip was recorded separately. A number of photographs were taken of the different areas showing seed trees, seedlings, etc. The crew generally consisted of three men, one compassman, who also helped count seedlings, one man making counts and observations and one man taking notes and tallies. This proved a speedy combination and covered almost twice as much ground as with just two men, although it was necessary to limit the crew to two men during

part of the time.

A large volume of data was obtained in this study which has since been tabulated for each area. Lack of space makes it possible to include at this time only a brief discussion of the main points brought out and the conclusions to be drawn from them. A complete progress report will be issued later in the winter for those who wish to go into the details.

3. Points Brought Out by the Studies.

a. A cutting in 250 year old white pine and hemlock made ten years ago by a private company, in which all merchantable timber was removed from an entire quarter section, and on which the brush was simply thrown out of the way of logging and has not been burned since, showed a good and well distributed stand of white pine seedlings over most of the area, where the ground was not too heavily shaded by standing hemlock. These seedlings were mostly 8, 9 and 10 years old, majority being 9, and were found just as thickly 20 chains from seed trees as close to them. Two small patches which had been burned since the cutting, although in an equally or more favorable position to receive seed than the unburned ground showed no reproduction of white pine, whatever. This seemed strong evidence that the seed which produced these seedlings had been sown by the previous stand before cutting and had lain over in the duff and germinated in the years immediately following the logging.

b. All of the areas furnished more or less evidence that a large part of the white pine reproduction found had

resulted from seed which had been sown by the old stand previous to cutting. Several cuttings had been burned broadcast leaving only occasional unburned patches, yet with over 90% of the soil severely burned and with seed trees close by which were known to have produced at least one seed crop since cutting, practically all of the white pine seedlings found were growing on the small proportion of unburned ground. It is not reasonable to think that if the seed had been distributed from seed trees after cutting and burning, it would have germinated and survived only on the unburned ground, since it is known to germinate and survive well on mineral soil.

c. Wherever migration since cutting or burning was clearly shown as in the case of severe broadcast brush fires or widespread crown fires such as the one on Upper Priest Lake, it was found that white pine seed had occasionally been blown as far as 1/2 mile, that scattering migration had taken place from four to 15 chains to windward of seed trees when the wind had the sweep of the lake. Complete restocking of this specieswas nowhere found to be taking place, however, within a period of four to ten years, at a greater distance than three chains from seed trees. On one four-year cutting migration had taken place as far as 5 chains to the extent of 250 per acre and it is possible that this might become fully stocked in ten years, although some ten year cuttings equally well situated do not seem to

prove it.

4. Tentative Conclusions Based on These Points.

Items A and B under the Coeur d'Alene study, page 56, are strengthened by such additional evidence and apply equally well to the Kaniksu and Pend Oreille work. On the latter work, however, many poorly stocked and over mature stands of timber were encountered whose seeding power per acre would be much less than the heavy young stands on the Coeur d'Alene. It cannot be concluded so definitely that it would be safe to depend upon possible seed in the duff for restocking in the case of these over mature stands, although there is much evidence pointing that way. It is thought that in cutting such stands seed trees should be left as a necessary precaution to insure regeneration. Removing the stands in a series of two or three partial cuttings within a few years of each other might serve this purpose if practicable from other standpoints and would take advantage of both seed stored in the duff and seed produced after cutting.

Further Work Planned:

It was considered desirable to concentrate on the question of the storage of white pine seed in the duff and distance of migration from seed trees. In doing this many opportunities for rounding out the work and taking notes on other interesting features, laying out permanent sample areas for periodic study, etc., had to be overlooked. In 1914 similar work will be done on other available cut-over

areas and burns and an effort will be made to make the study more complete by including the above points. The white pine type will continue to receive most of the attention. In addition there will probably be opportunity to start some complete experiments on projected cutting areas in which a test will be made of our present ideas on the best methods to be used under different conditions.

As in 1913, this project will be considered the most important work of the Station and will be pushed as vigorously as is possible with our means and at the expense of several of the other projects, if necessary. In studying cut-over areas and recent burns, the ideal time is in April, May and June, just after snow goes off and before the growth of weeds and leaves of brush become dense enough to obscure the surface more or less. This growth is a serious factor in reducing the speed of a crew and in making the work liable to omission and slight errors. With all of the spring nursery and planting work on our present program however, it will be difficult, with the present permanent force and the small sum available for temporary assistance, to do much on this project before June without serious curtailment of the other work. Every effort will be made to get this desirable early start, however.

Project Mr-1, D-1, Priest River

Title: FACTORS AFFECTING NATURAL REPRODUCTION

Western White Pine

Object:

To determine amount of and causes for loss of some seedlings and persistence and vigor of others in stands of all ages and degrees of density.

Work Previous to 1913:

Five permanent sample plots were charted on recent cut-over areas, in the fall of 1912, located close to seed trees in such a way as to show successive seeding in and survival.

Work Done in 1913:

Above sample plots were recounted fall of 1913 and recharted, to show survival and new migration.

An intensive ecological experiment was installed at the three meteorological stations to study the life history of seedlings during the first years after germination under closely controlled conditions with important factors of the habitat closely recorded and germination and death followed by frequent detailed counts, cultures of dead seedlings, charts of location, etc. Two nursery screens, 4x12, were used at each station to inclose areas suitable for the experiment. One bed at each site was entirely in the open and the other in the typical shade characteristic of that site,--young timber at Station I, willow and juneberry brush at Stations II and III. The

beds in the open were so placed that one-half consisted of ground severely burned by brush fires and the other half was covered with grass, herbage, and evergreen shrubs characteristic of the site. The beds in the shade were so arranged that the roots of the surrounding brush and trees ran into the area. A ditch deep enough to cut all roots was dug around one half and then filled and the vegetation cover was removed. The other half was left covered with the natural vegetation and the roots left uncut.

Seed of six important species found in the white pine region,--white pine, western larch, Western Red Cedar, Douglas Fir, Western Yellow Pine and Western Hemlock,-- was then sown in each half bed in plots 2 feet square, late in April. Samples were first soaked in cold water to simulate soaking of naturally sown seed in rain and snow and then broadcasted and lightly scratched in with a rake, in such a way as to insure a stand and yet not disturb the vegetation present.

In addition to the regular meteorological data obtained at each station, observations included:-

1. Daily readings of soil temperature at surface, six inches and twelve inches, with maximum and minimum surface temperatures.

2. Taking of soil moisture samples at surface, six inches and twelve inches, once a week.

3. Weekly count of germination and survival, with

record of first germination.

4. As close record as possible of causes of death obtained by cultures of damped off seedlings and frequent observations.

5. Comparison of development and survival of seedlings germinating at different times in the season by marking each month's germination with different colored toothpicks.

6. Detailed charts made in latter part of season showing relative location of seedlings and plants in the "Natural" plots.

The season's work was thoroughly and efficiently handled by E. C. Rogers of the Station force and some interesting results were secured, some of the more important of which are shown in the attached table:

Conclusions on figures shown in Table.

1. White Pine

a. Germination better in shade and in general better on natural surfaces.

b. Survival much better in the open and on mineral surfaces. Damping off worse in shade.

c. Station I much the best site.

2. Western Yellow Pine

a. Germination about the same in shade and open but much greater on mineral surfaces.

b. Survival better on mineral surface and in the open. Damping off more serious in the shade.

c. Station III best site.

3. Douglas Fir

a. Germination better on mineral surface and in the open.

b. Survival better in the open and on mineral surface. Damping off most serious on natural surface.

c. Station III most favorable site.

4. Western Larch

a. Germination generally better in ~~shade~~ open and much ~~better in shade and much~~ better on mineral surfaces.

b. Survival much greater on mineral surfaces, advantage varies with the different Stations between shade and open.

c. Damping off more serious in the shade and generally on natural surface.

d. Ninety per cent loss under heavy shade in bed B compared to 55% in open

e. Station III most favorable site.

5. Western Hemlock

a. Germination greatest in full shade and on natural duff covered surface.

b. Survival better on mineral in open and on natural in shade.

c. Station I most favorable site.

6. Western Red Cedar

a. Germination better in the shade and on mineral surface.

b. Survival better in the shade and on mineral sur-

face.

c. Station I best site.

The figures given in the table are only the barest skeleton of the data collected. In the complete progress report many other interesting points will be brought out.

Further Work Planned.

Observations on survival of the seedlings obtained in 1913 will be continued through one or more additional seasons with possibly some additional sowing of new plots to clear up doubtful points.

More permanent field plots will be established for close study of germination and survival under natural re-seeding.

Project Mt-1, D-1, Priest River.

Title: EFFECT OF DIFFERENT DEGREES OF THINNINGS

Western White Pine
Western Larch
Lodgepole Pine
Douglas Fir
Western Yellow Pine

Work Previous to 1913:

Some work done on the Deerlodge in 1911 and 1912 but no investigative work by the Experiment Station.

Work Done in 1913:

In July, four plots, one half acre in area, were laid out in a fifty-year odd stand of white pine, larch and mixed species on Benton Flat close to the Experiment Station buildings. The stand on these plots was quite uniform in character and situation and the plan was to leave one untouched, as a check, and to thin the others in three different ways or degrees. A detailed examination was made of these plots in November and December, in which the trees were classified into several crown classes and into an upper story of the pines, fir and larch and an understory of cedar and hemlock. Classification was made according to the system adopted by the Swedish Experiment Station for thinning plots as given in the Forestry Quarterly and appeared in practice to be a very natural and suitable division, the classes of which were readily recognizable.

Further Work Planned:

The charts will be worked up during the winter and

a working plan for the thinning, based on what is on ground, will be prepared and submitted for approval. The thinning will then be done in accordance with this plan.

If there is opportunity, another series of plots in some different stand on the Experiment Station territory will be laid out and plotted. It is thought however, that 1914 work will have to be limited to the marking and thinning of plots already initiated, in view of other more urgent work.

A plan which would cover the initiation and completion of one series of plots during each season for the next five years would put the work on a thorough and sufficiently comprehensive basis. Re-examinations are planned every five years so that the first series would be re-examined the 6th year - 1919, the second series the 7th year-1920, etc. This would give to the project its correct proportion of the time and attention of the Station.

Project TS-1, D-1, Priest River

Title: WESTERN WHITE PINE TREE STUDY

Work Previous to 1913:

No direct investigations by Experiment Station although the results of some other projects might be of use.

Work Done in 1913:

In connection with the project on methods of cutting, Mc-1, some work was done in the study of white pine seed distribution and fertility which could be properly assigned to this tree study. In order to confirm if possible the theory that white pine seed could lie over in the duff from the previous stand and germinate one, two, or three years later, J. A. Larsen of the Experiment Station force, spent considerable time during August searching for seed beneath mature stands of white pine timber. Eleven plots 1 foot wide and 25 feet long were examined by going over all of the duff and litter minutely with sieves and by hand. An average of one apparently good seed per square foot was found under both 140 year and 250 year stands of white pine timber. Subsequent germination tests failed to show any results from the total number of 275 seed collected and cutting tests showed many of the seed to be hollow and discolored. A few were firm and white, however, and looked alive and healthy. But the fact that no germination was secured from 275 seed proves nothing, since almost 50,000 appear to be distributed on an acre and if only 1% were good,

a fair stand of seedlings would be produced.

The question of white pine germination is an important one as it has a primary bearing on almost all of the management and nursery projects dealing with this species. Its peculiar faculty of lying over in the seed bed for two and three years after sowing, before it finally germinates, is well known and is one basis for thinking that it might do this in the duff, under natural stands. This point makes its handling in the nursery rather difficult and extensive experiments were undertaken in the winter of 1912-13 in trying to stimulate the seed by use of chemicals, heat, moisture, etc. These experiments were mostly negative but a large amount of ground was thoroughly covered by J. V. Hofmann who had charge of this work at the Station, which will not have to be gone over again. Soaking in full strength sulphuric acid was the only chemical treatment that had much effect and it increased germination only a small per cent.

Greenhouse work last winter showed that a noticeably higher germination was secured at 90° than at the ordinary 70° temperature. Further experiments in the spring by soaking first in cold water and then placing in a moist warm germinating chamber gave a fair increase. These two indications lead to the purchase of a poultry incubator in August for use in keeping the moist-chamber at any uniform temperature desired. Four samples of white pine were treated in the

PROJECT Mr-1, FACTORS EFFECTING NATURAL REPRODUCTION

Table Showing Partial Results of 1913 Season's Work, 1913.

Meteorological Station	Bed No.	Amount Shade	Surface Conditions	W.White Pine				W.Yellow Pine				Douglas Fir				Western Larch				Western Hemlock				W. Red Cedar			
				No. Germ	Survival: No.	Survival: %	loss: % Fungi	No. Germ	Survival: No.	Survival: %	loss: % Fungi	No. Germ	Survival: No.	Survival: %	loss: % Fungi	No. Germ	Survival: No.	Survival: %	loss: % Fungi	No. Germ	Survival: No.	Survival: %	loss: % Fungi	No. Germ	Survival: No.	Survival: %	loss: % Fungi
No. I NE Slope	A	Open	Natural vegetation	228	192	84%	30%	234	119	51%	78%	50	19	38%	77%	130	29	22%	79%	101	38	37%	46%	13	6	46%	43%
White Pine Type	"	"	Burned	218	202	93%	56%	416	331	79%	58%	155	123	79%	40%	279	187	67%	73%	87	73	84%	43%	30	21	70%	33%
	B	Full Shade Young Timber	Natural vegetation	323	106	33%	96%	286	21	7%	82%	120	70	58%	80%	473	29	6%	92%	288	189	66%	33%	51	26	51%	40%
	"	"	Ditched and Denuded	289	53	18%	92%	395	20	5%	92%	147	57	39%	85%	684	74	11%	96%	261	107	41%	71%	61	32	52%	45%
No. II SW Slope	C	Open	Natural Vegetation	23	1	4%	50%	184	112	61%	67%	39	5	13%	74%	192	10	5%	87%	90	0	0.0	88%	8	0	00	50%
Yellow Pine Type	C	"	Burned	14	3	21%	73%	153	130	85%	56%	43	0	0	74%	145	59	41%	55%	1	0	00	100%	2	2	100%	0
	D*	Half Shade Willows	Natural Vegetation					10	0	0	30%	0	0	0	0	10	2	20%	70%								
	D*	"	Ditched and Denuded	2	0	00	100%	12	3	25%	67%	12	1	8%	18%	79	18	23%	70%	13	0	00	92%	0	0	0	0
No. III Sandy Flat. Western Larch-Douglas Fir Type	E	Open	Natural Vegetation	64	46	72%	67%	176	148	84%	35%	155	132	85%	52%	205	106	52%	67%	29	6	21%	26%	15	9	60%	67%
	"	"	Burned	146	133	91%	54%	455	389	85%	50%	226	179	79%	47%	627	542	86%	73%	121	50	41%	74%	20	13	65%	43%
	F	Half Shade Service Berry Quarter Shade	Natural Vegetation					105 ##	30	29%	95%	49 ##	17	35%	100%	73 ##	16	22%	100%								
	"	Service Berry	Ditched and Denuded	16	16	100%	0%	714	641	90%	92%	358	304	85%	59%	814	661	81%	69%	10	6	60%	100%	1	0	00	100%
Average						52%	85%			50%	79%			43%	70%			36%	85%			35%	62%			44%	44%

*All results in bed D seriously affected by rodent trouble, partially destroying value for comparison.

Twice as much seed Yellow Pine, Douglas Fir and Larch sown beds D and F as in other beds.

incubator for different lengths of time and sown in a seed bed in September. Although put in necessarily at a poor time of year, this work gave indications of considerable promise, a germination of 50 per square foot or 1/3 of green house germination having been secured between September 24 and November 3. This is noticeably better than is obtained in spring sowing in the nursery with dry seed. A more extensive series of experiments will be undertaken along these lines next spring, if seed of white pine can be obtained.

Further Work Planned.

Aside from the germination experiments in the nursery, mentioned above, more work will be done along the lines of germination, dormancy and survival of seed and seedlings in natural stands. If good fresh seed had been obtainable this fall, a series of seed lots was to have been placed beneath the duff of a mature stand to be left there 1, 2, 3, years and so on up to ten years. Each fall thereafter, one lot was to be taken up and germinated to show how long the seed retained its vitality under these conditions. This will be undertaken in the fall of 1914 if possible.

Plans for other work of this sort have not yet been formed but will be worked out later in the winter. As an adjunct to the project on methods of cutting, this work is of considerable importance and will be given a prominent place in the next season's program.

A reclassification of the work under a new project designation (see Fs-5 below) is advisable, however, since project Ts-1 will be terminated in March, 1914.

Proposed New Project Fs-5, D-1, Priest River

Title: GERMINATION OF WESTERN WHITE PINE SEED

Object:

To determine the characteristics of germination of western white pine seed at various periods after ripening and under the influence of different physical and chemical factors. Information on this subject is badly needed for use in our studies of methods of cutting and natural reproduction of this species and also in both practical and investigative nursery work. The study is considered distinctly basic and should be pushed.

Status:

Previous work includes the chemical and physical stimulation experiments carried on under project TS-1. Since the latter project will be completed March 31, 1914, and since there is much more work to be done along this special line, it is thought that this work on germination should be reclassified as a distinct project under "Seed".

Further Work:

Stimulation will be tried by means of other chemicals and particularly by variations in heat and moisture effected by the use of an incubator. A microscopic study of the seed structure will also be made in connection with

green house experiments in germination and an effort will be made to determine the part played by ozygen and moisture and heat in starting growth of the seed cells.

Proposed New Project Fs-6, D-1, Priest River

Title: SEED PRODUCTION - WESTERN WHITE PINE

Object:

To determine the amount and quality of seed produced by western white pine trees which are distinctly over-mature and decadent. Information on this matter is needed for use in timber sale work in determining the value of such trees when left for seeding purposes. These trees are usually scattered and are large and particularly valuable because of the amount of clear lumber in them. It is thought this lumber value will often so far exceed their value as seed trees as to warrant clean cutting and planting, if necessary, rather than to invest such a large amount for securing natural restocking.

Status: Nothing definite is known on this matter.

Further Work:

It is planned in the fall of 1914 to visit cutting areas containing large, over-mature trees and to collect the cones from such trees and germinate the seed. Operations will be located only on areas where active logging is going on so that there will be no expense for felling trees. The necessary notes and measurements regarding each tree will be taken in connection with the cone collection. The work can be handled in such a way as to serve the purpose and yet not require much time or expense.